POWER TOPICS CROSS-INDEX

STEAM GENERATION · POWER GENERATION · WATER POWER · DIESEL & GAS ENGINES · AIR CONDITIONING & HEATING · REFRIGERATION · PUMPS & COMPRESSORS · STEAM SERVICES · ELECTRICITY & ELEVATORS · INSTRUMENTS & CONTROL · PIPING SYSTEMS · MECHANICAL TRANSMISSION · POWER MISCELLANY

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OCTOBER, 1939

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Let Steam Head Turbine... YOU

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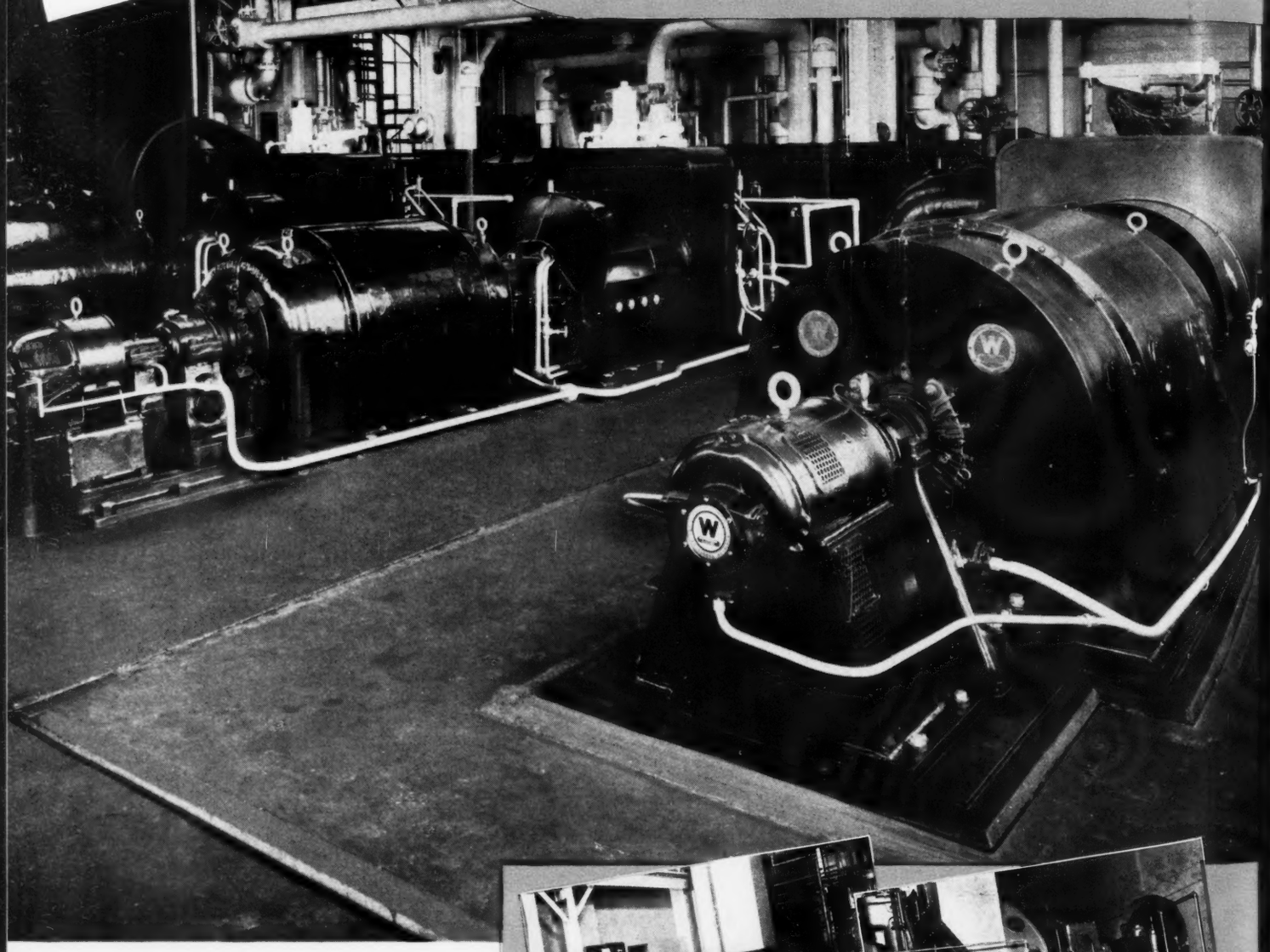

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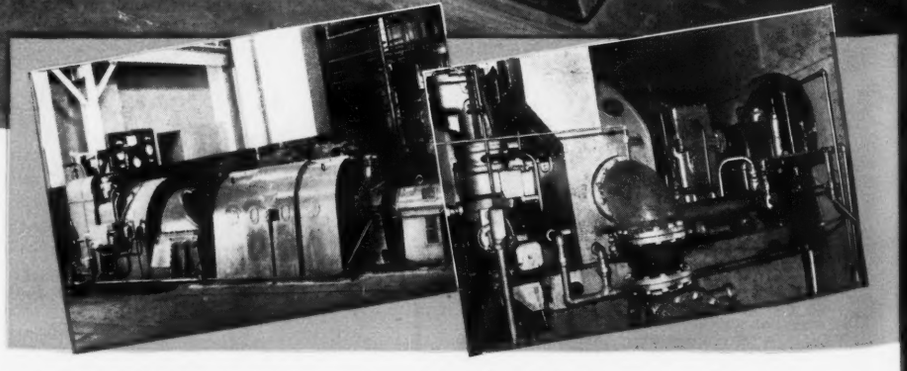

CONDENSING—1000-kw. turbine-generator operating with steam at 400 lb. per sq. in., 600° F. total temperature, and exhausting at 28 in. Hg. vacuum.

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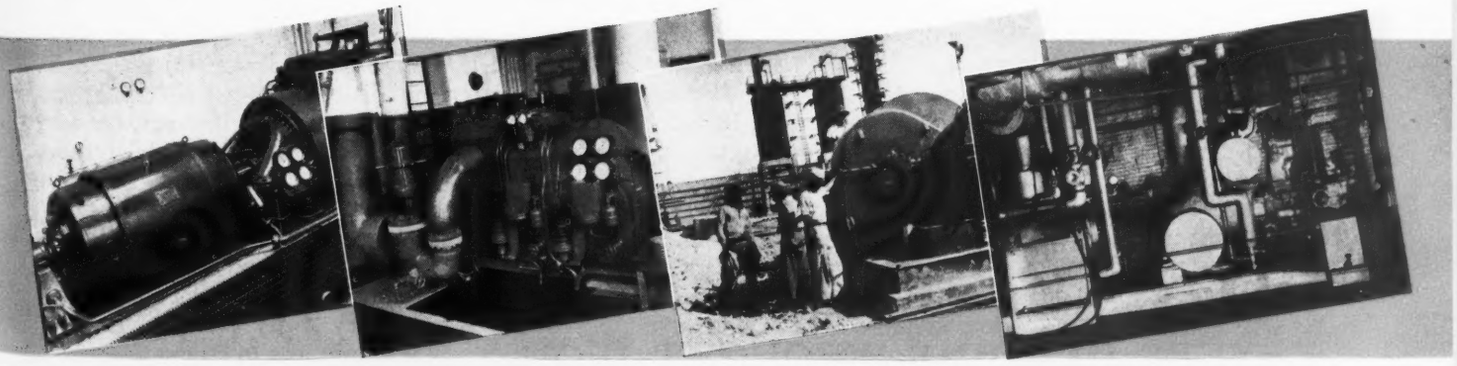

CONDENSING EXTRACTION — 750-kw. turbine uses steam at 185 lb. per sq. in., 480° F. total temperature, extracts at 25 lb. per sq. in.

NON-CONDENSING EXTRACTION — 1500-kw. unit operating with steam at 450 lb. per sq. in., 620° F. total temperature.

CONDENSING — 294-hp. unit operating with steam at 525 lb. per sq. in., 700° F. total temperature, exhausting at 28 in. Hg. vacuum.

NON-CONDENSING — This 1100-hp. turbine uses steam at 200 lb. per sq. in., 530° F. total temperature, exhausts at 30 lb. per sq. in.

Steam Service

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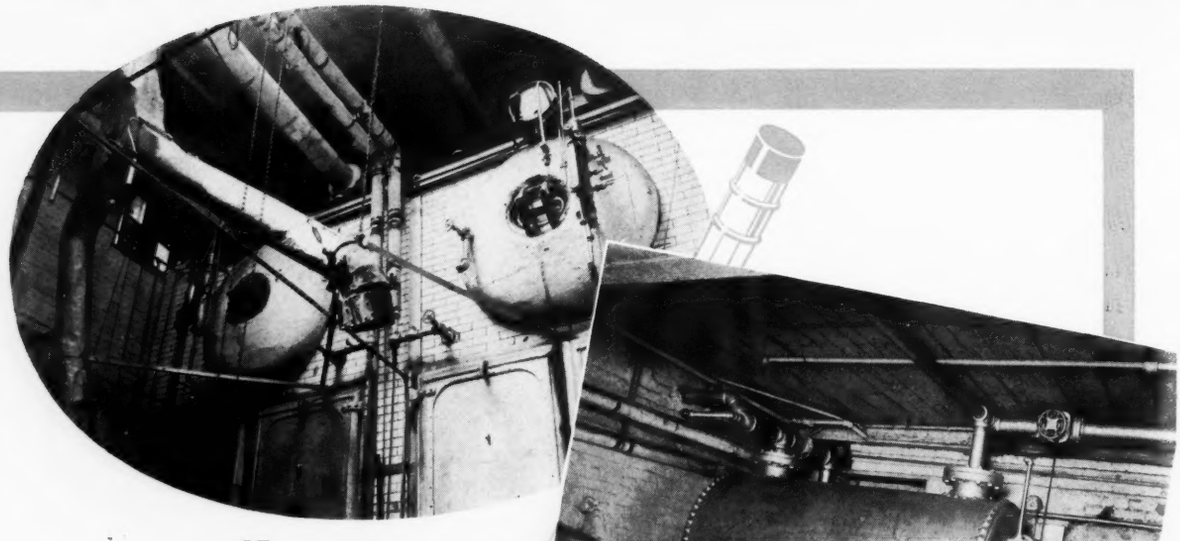

AT

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The other illustration shows a boiler feed water tank. It and the piping are also wrought iron . . . and also thirty year veterans. Not illustrated are two stacks, with wrought iron bottom sections still on the job after 30 years. In addition to these services, the company uses wrought iron for steam returns, heat exchanger tubes, and hot and cold water lines. Selection of wrought iron for the hot and cold water line was made as a result of comparative service tests.

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BUSINESS
Stands Against War

Let us take a clear-eyed look at this thing we call War.

WAR is a political tool for domination or suppression; a device of futility—unless it be waged in defense of our homes, our property or our rights—in the preservation of our liberty. War destroys everything it touches. So completely does it disrupt the order and progress of civilization that humanity falters.

Dangerously widespread amongst our people today is the assumption that our participation in the European War is inevitable. Some mistrust the temper and program of the federal government as likely to lead us into it; others fear that our sympathies will make us an easy prey to the propagandists; still others suspect that business and industry, in a blind greed for profits, may involve us in the conflict.

To give credence to such beliefs is to deny that we are normal individuals, endowed with intelligence and a will, or the ability, as a people, to profit by our own experience. In all human experience, death only is inevitable.

To say that Industry and Business want war or will encourage, directly or indirectly, our participation in the present war, is a vicious and deliberate lie.

The millions of us who, since the World War twenty-five years ago, have devoted all our efforts and energies to creating and building and improving that which we know today as American Industry and Business, are convinced that the destiny of this country can be wrought only in peace. We cannot, and *must* not, stand aside and watch even the little progress we have made since that war sacrificed to the pestilence of another world conflict. We who are trying to build a lasting heritage for those who will follow us truly know that "there never was a good war or a bad peace".

Perhaps it is time to re-emphasize two of the three elements of our democratic faith, so simply stated by Abraham Lincoln, "that government of the people, by the people, for the people, shall not perish from the earth". Now, of all times, it will be wise to inform our political stewards that government by the people and for the people must be the guiding principle in what they do during the days to come, and that it is our *will* that in our country peace shall be preserved.

Only the grim and solitary courage of each of us, the determination to exert all our intelligence, all our individual influence in every way, can insure the preservation of peace for our country.

Preparedness we know to be the most effective preventive weapon against the threat of war. We must be certain, therefore, that we provide our air, land and sea forces with the best in armaments and material, in adequate supply to maintain properly and impressively our national responsibilities and defense.

Most important is that we as individuals, thus inspired, band together to exert the full strength of Industry and Business in the maintenance of peace.

If we are to succeed, we must be forceful, we must be articulate. To that purpose we pledge ourselves and the resources of our publications. An expression from our readers will greatly assist in such a mobilization of industrial opinion. Together, in this critical time, we can serve America well!

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

POWER

Established 1882 PHILIP W SWAIN, Editor

Fuels—Power—War

How will this new world war affect the plants, loads, fuels and jobs of the power engineer?

Let's start with the answers, as we see them after surveying the situation and consulting many sources of information in the McGraw-Hill organization and out. Then, next month, we can go into more details and reasons.

The basic economic effect of any major war is dislocation of the existing setup. Business goes on, but not "as usual." Production shoots up in one line, down in another. Foreign trade is first disorganized, then reorganized along new lines. Time-honored policies and price patterns are smashed overnight. Habit becomes a false guide. War forces every business man, every engineer, to restudy his job in the light of new events, then build himself new landmarks.

To help the engineer in this task, we present here the new power situation as we see it:

Fuel prices have risen and will keep on rising. Both coal and oil will go up, but oil more than coal, we expect. No immediate fuel shortage seems possible, but we may ultimately look for much higher coal and oil prices if the war drags on. If America is eventually drawn into the conflict, there may come another 1917 with its acute coal shortages and coal rationing. As before, the likely cause would be overtaxed transportation.

In fairness, we should point to sharp disagreement on this last point. Railroad equipment is admittedly in bad shape, but the roads have recently publicized their ability to handle a 25% increase in traffic just as they stand, and 50% with rehabilitation of existing out-of-order cars and locomotives.

In the last war there were many causes of local power shortage, but mostly as a direct result of fuel traffic jams. Granted a dependable fuel supply, the electric utilities are confident that they can take care of any possible growth of the war load. Some local pinches may arise, but authoritative opinion leans toward no widespread failure of public supply.

Steel, definitely a "war baby," has already reacted sharply to the emergency situation. Production and prices are way up and may go higher. This trend will surely affect all kinds of machinery—heavy power equipment in particular. We look for rising prices of boilers, turbines, engines, generators and hundreds of kindred power items.

This condition will be accentuated as Latin America, cut off from its German suppliers, turns to us for its major power equipment and supplies.

Where a reader finds that his plant is likely to require new equipment within the next year or two, it would seem wise to order promptly to avoid still higher prices and possible delays in delivery.

Plants now burning oil should immediately prepare for rising oil prices by extending favorable contracts, if possible, and, in some cases, by getting set to burn coal if the need arises.

Coal-fired plants should check their fuel-burning "versatility"—their ability to shift to another variety of coal if price changes or shipping difficulties should make it necessary.

Some industries must prepare at once to increase productive capacity. Others, more slowly affected by war demands, can safely "sit tight" for a while.

In no case, however, is there any reason to delay a general checkup and maintenance drive. Is all equipment in the best possible shape? Have you enough dependable capacity to handle two- or three-shift operation at present load levels or higher? In checking this have you allowed for the resulting more rapid deterioration of boiler brickwork?

Have you a reasonable stock of wire, cable, fittings, pipe, valves, ready for instant servicing of emergency needs in power plant and factory?

What about steam supply for process? When the need arises, you can't get it from the central station or go out and buy it by the bucket.

These are matters for early consideration. We can't say which will prove decisive in the final test, but we do know that everything should be lashed down before the full force of the storm arrives.

In time of war, no one can predict just what will happen. Figure the possibilities. Make flexible plans to meet them. Watch and work!

Ottawa Street, Lansing—Stackless Station of Tomorrow

When a municipal plant leads central-station practice, that's news. Expert opinion may differ as to detail, but Lansing's combined power and steam-heating plant reflects the best there is in architecture, engineering, equipment, economy, and provision for near-perfect operation

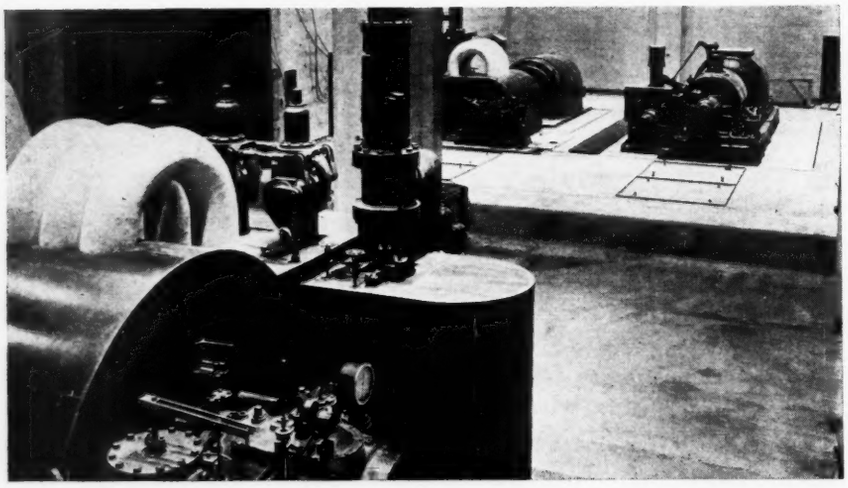

Fig. 1—Main 25,000-kw condensing turbine in foreground serves bulk of power load; 4000- and 2500-kw backpressure units in background exhaust to heating mains

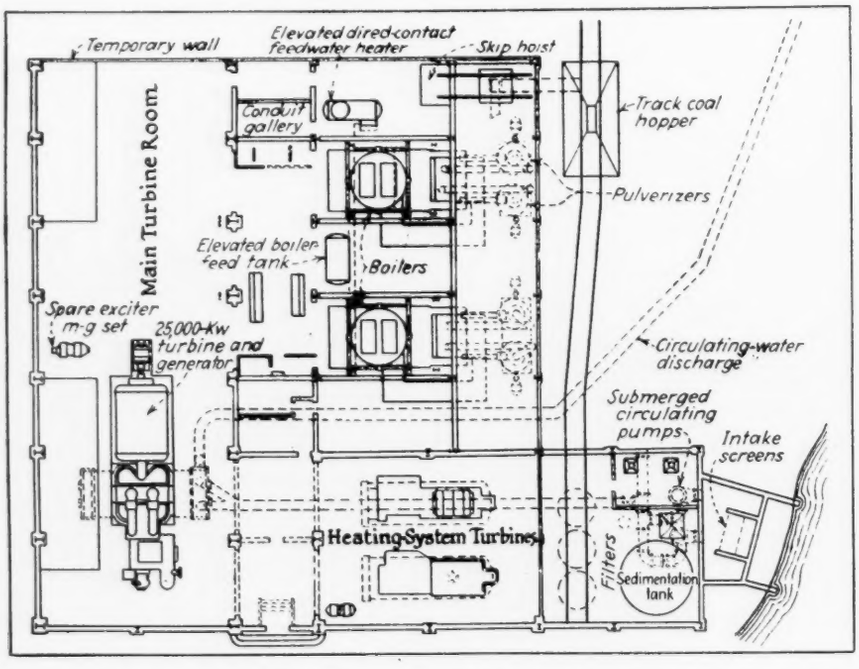

Fig. 2—Turbine plant is divided into main turbine room for power generation, transverse hall for heating-system turbines with water-treating equipment and evaporators

ONLY TWO CITY BLOCKS from Michigan's Capitol building, the newest addition to Lansing's municipal electric and steam supply combines extraordinary beauty of architecture with efficient and serviceable equipment. In mechanical and electrical design, as well as architecture, the plant compares favorably with the best modern central-station practice.

While the plant is not yet in operation and therefore no results are available, unusually high boiler and turbine-room efficiencies are to be expected from the calculated performance. Inspection reveals attention to details of heat balance and construction that are bound to lead to efficient and reliable operation.

Pulverized-fuel firing, superheat control at operating pressures of 850 lb. 900 F, 6-stage feed heating with four direct-contact heaters, premeasured combustion control, air preheaters and electrostatic precipitators, hydraulic-coupling speed control of auxiliaries, triplex boiler-feed pump for light loads, and 2-stage byproduct power with evaporators to supply district heating steam bring to a single plant what it takes to make power at low cost with minimum nuisance to nearby public buildings and business community. And the money to buy it all came from the earnings conserved by good management over past years.

Lansing has a long history of municipal or community-owned electric-light and steam supply, dating back to about 1890. In 1919 an increased load area and a district-heating system were inherited by purchase from a competing company. In 1923, the first two units, 10,000 and 15,000 kw respectively, were installed in the Moores Park Station (POWER, June 19, 1923). Later extension brought this plant

capacity to 55,000 kw. Electric and steam operations are controlled by a non-salaried, non-political Board of Water & Electric Light Commissioners under a charter which prohibits use of power and steam income except for the benefit of consumers, extension to plant, and expenses for the operation of the system.

The property is operated under efficient management and competent supervision, in exactly the same way that any good utility property would be operated, and is, therefore, entirely comparable to the operation of the best privately owned utilities. This goes to show that the success of such undertakings is a function of management and supervision, not of ownership.

Site for the new Ottawa St plant, on the Grand River close to the business district, was earlier occupied by a small steam-heating plant, of which part of the boiler room still remains. Architecture of the new building, black marble base, hard-burned blue brick gradually merging to red and dust-yellow as top of turbine room and boiler tower are reached, symbolizes coal burning. Complete absence of visible stack leaves color scheme the only clue to the utilitarian nature of the building. The tower housing the boiler equipment is about the height of a 16-story building.

Boiler House

In the boiler house, two 225,000-lb-per-hr steam-generating units with continuous-tube economizers and superheaters are designed to operate separately, one supplying main power-generating turbine, the other, the steam-heating load. Steam and feed piping, however, is valved and interconnected so that either or both boilers can be used for either or both services. Two-stage furnaces drip slag continuously from primary-furnace floor into secondary-furnace hopper ash sluice. Flyash from the precipitator is forced into furnace below slag line by a ram plunger and all ash is sluiced into an elevated steel tank in the yard for truck disposal.

Rail-borne coal is elevated from a track hopper to an 800-ton structural-steel raw-coal bunker inside the walls by an inside-out skip hoist. The latter, completely enclosed, occupies minimum space by having bucket travel outside the rails, turning over to supply a transverse distributing belt.

One pulverizer supplies each of two burners per boiler. This arrangement permits continuous measurement of the coal to each mill-burner combination. Ingenious synchronous-motor-driven

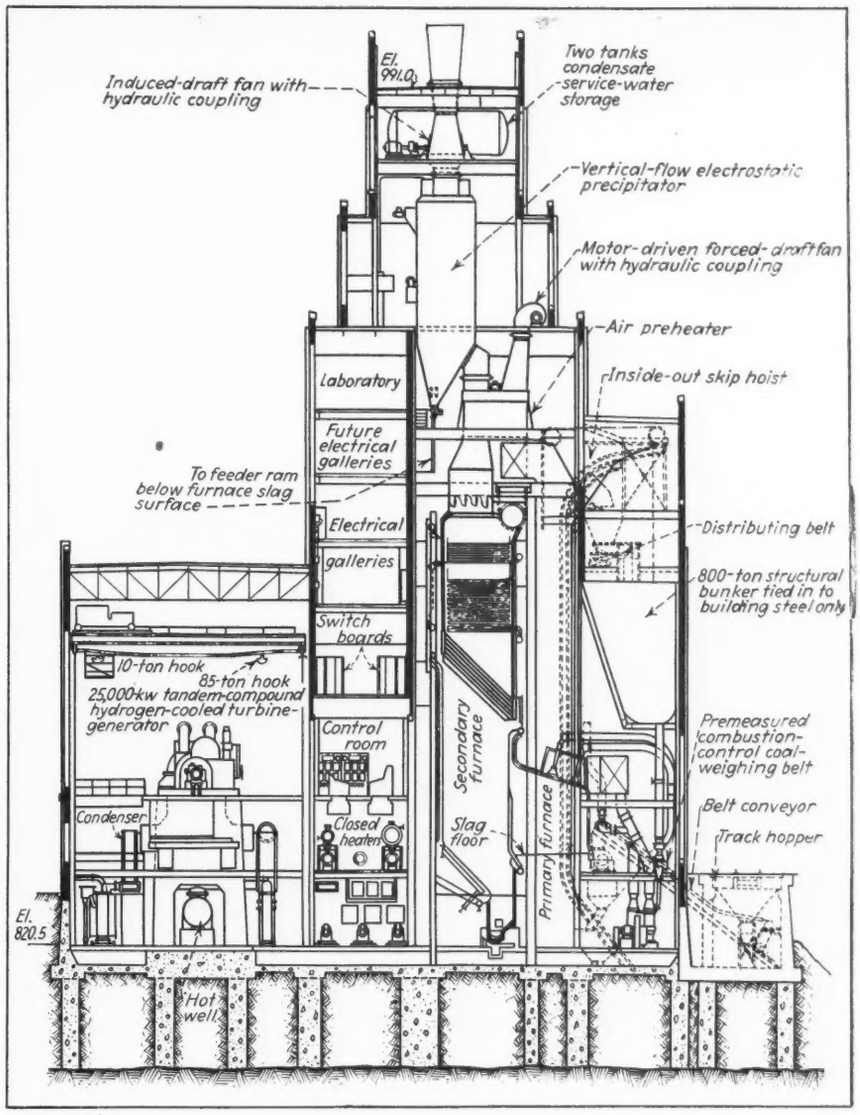

Fig. 3—Cross section of 170-ft high stackless boiler house which permits attractive architectural treatment of plant exterior. Note strategic location of control room

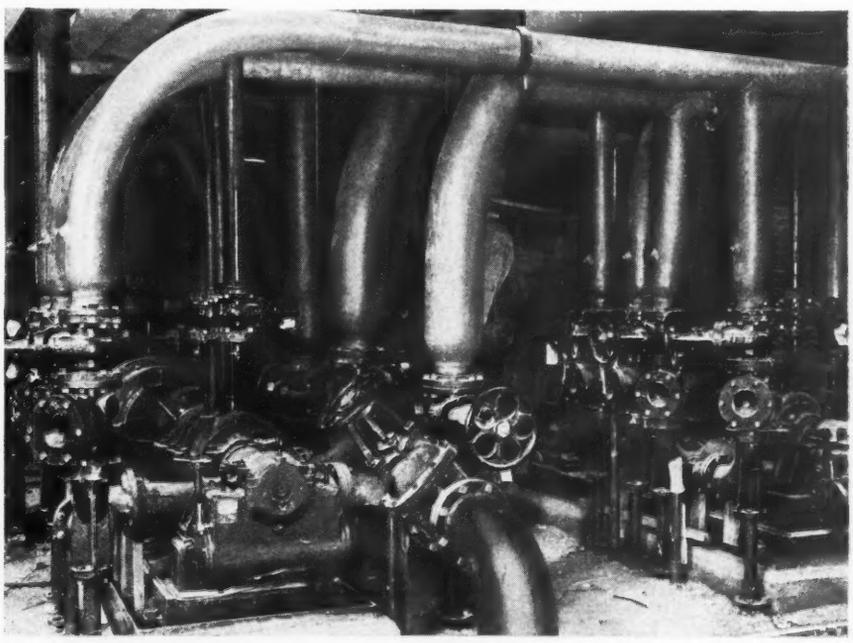

Fig. 4—Motor-driven 4-section pumps circulate condensate through direct-contact heaters

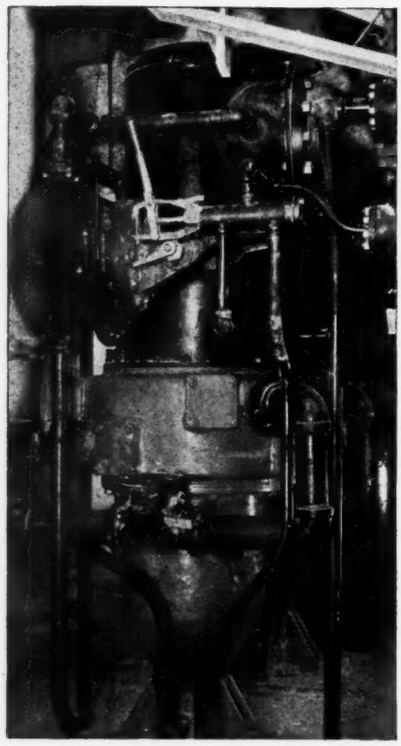

Fig. 5—Direct-contact units heat condensate practically to bleed-steam temperature

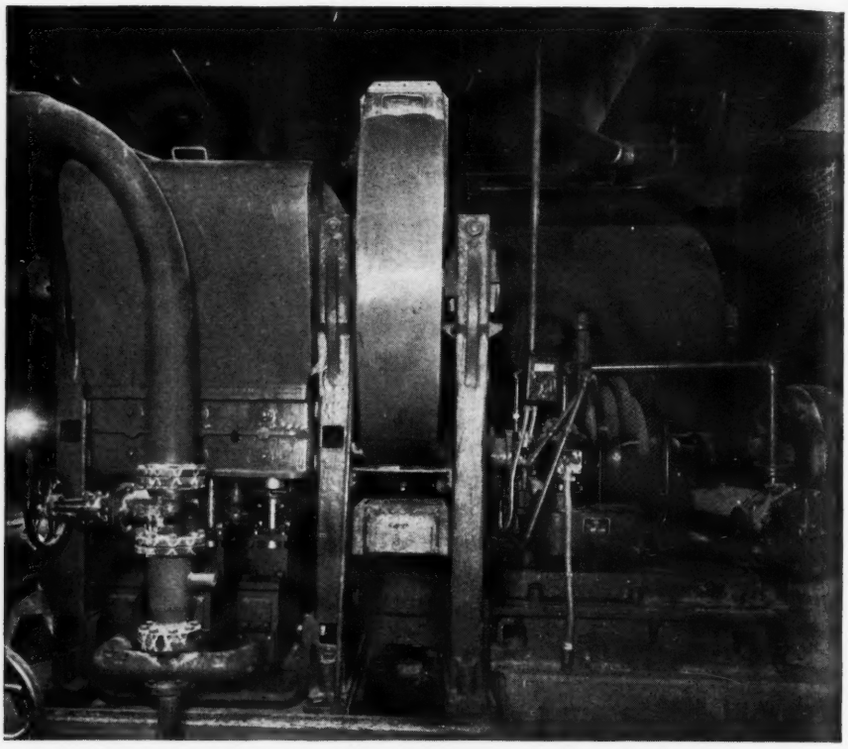

Fig. 6—Motor-driven through hydraulic coupling for speed control, this triplex pump handles light loads efficiently. Note gland nuts chained together to assure even take-up

3-ft-long belt on an aluminum carriage does the weighing; amount of coal on the belt at any instant is directly proportional to lb-of-coal-per-hr feeding rate. Quantity can be read on adjacent dial scales, or by Selsyn transmission on meters in the control room. Impulse from coal weight is coordinated with air flow to burner by automatic combustion control. All three essential quantities (primary, secondary air and coal-feed rate) are indicated in control room on meters with special chart rulings that tell at a glance if predesignated combustion conditions are being maintained.

Setback of building walls just above boiler-drum level results in unusual vertical arrangement of air preheater, Fig. 3, precipitator and induced-draft fans. Gas-flow path is practically straight upward. Heretofore, most precipitators have been designed for horizontal gas flow; the new vertical-flow unit fits in small horizontal dimensions. Both plates and hopper are continuously vibrated.

Two induced-draft fans per boiler with hydraulic-coupling speed control exhaust to common 20-ft-high évasé stack completely concealed by a surrounding parapet. Smoke-indicating equipment guards each stack. Degree of blackness is recorded on a meter on the gage board. A smoke alarm is actuated by the same device.

The turbine room, Fig. 2, is L-shaped. The lengthwise hall is intended for power generation; the transverse section houses two backpressure turbines, evaporators and feed-treating equipment for district-heating supply. One 25,000-kw, 3600-rpm condensing turbine with hydrogen-cooled generator and geared exciter will start operating this Fall. The present building will accommodate a similar unit when needed.

Both turbine rooms are lighted by combination mazda and mercury-vapor units yielding a light intensity of about 20 ft-candles at the operating floor. Main turbine-room crane rails extend through the temporary end wall of the building so that heavy equipment can be unloaded from flat cars directly into the turbine room. Entire upper part of the temporary wall forms a huge door which swings upward to afford passage for the crane.

A similar arrangement in the heating-system turbine room allows a single crane to service turbines and feed-treating equipment. A spur track leads into the ground-level floor between turbine room and treatment house.

The main turbine unit has six bleed stages, four direct-contact and two closed tubular heaters, taking fullest advantage of the regenerative cycle. Flow

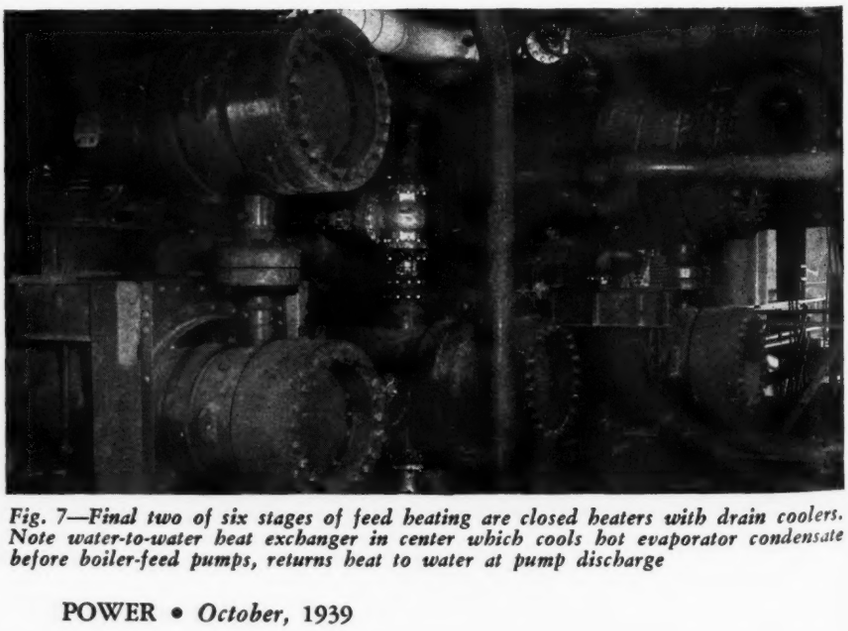

Fig. 7—Final two of six stages of feed heating are closed heaters with drain coolers. Note water-to-water heat exchanger in center which cools hot evaporator condensate before boiler-feed pumps, returns heat to water at pump discharge

diagram, Fig. 8, illustrates the normal operating cycle. Condensate drains from the condenser into a 5000-gal. deaerating storage tank from which it flows in oversize piping to the 4-section condensate pumps, Fig. 4. First section takes condensate through inter-condensers of the 3-stage air-ejector, oil cooler, and generator hydrogen cooler, into 6th-stage direct-contact heater. The latter, and other contact heaters, are equipped with vent condensers. Air-ejector drains are trapped to the condenser shell.

Returning to the second section of the pump, condensate is delivered to 5th-stage heater, Fig. 5, exactly like the 6th-stage unit. The third pump section carries the flow through air-ejector after-condenser before delivering it to 4th-stage heater which is also a deaerator.

Fourth section of the condensate pump delivers sufficient head to take flow through the evaporator condenser to an elevated deaerating heater high in the boiler house just below the boiler-drum level. The latter provides the last of three stages of deaeration, considering that the first occurs in the condenser hotwell. Elevation of this heater assures adequate positive head on the boiler-feed pumps at all loads. Pressure in the heater varies from about 5 lb g, at quarter load, to 55 lb g, at full load.

Boiler-Feed Pumps

Three motor-driven boiler-feed pumps supply normal-load service. For light loads, a slow-speed triplex piston pump of high efficiency affords an appreciable saving in auxiliary power. The triplex pump has hydraulic-coupling speed control, the centrifugals operate at constant speed with squirrel-cage-motor drive. These pumps are the only equipment common to district-heating-supply turbines and main power unit. By a duplicate-header and valve arrangement, any combination of pumps can be isolated to serve either cycle.

Remaining two stages of feed heating are, of course, closed heaters with full boiler-feed pressure in water boxes and tubes. Each has a drain cooler, Fig. 7, to reduce heater condensate to lowest possible temperature before it is trapped to next lower heater. Final feedwater temperature ranges from 330 F at quarter to 440 F at full load.

Makeup evaporator for the main tur-

Principal Equipment—Ottawa St Station

BOARD OF WATER & ELECTRIC LIGHT COMMISSIONERS, LANSING, MICHIGAN

BURNS AND ROE, INC, CONSULTING ENGINEERS

Steam-Generating Equipment:

Boilers, 2, sectional-header, single-drum.....Babcock & Wilcox Co
High-head type, 2817 sq ft heating surface, 225,000 lb per hr capacity at 925 lb, 900 F, design conditions. Minimum operating pressure at superheater outlet, 845 lb. 18 sections wide, single setting, 20-ft inclined tubes. Single pass with dividing baffle for superheat control
Furnace, 8200 cu ft, 2 stage, cont slag tap.....Babcock & Wilcox Co
Water walls 3411 sq ft, stud tube, block, and bare tube
Superheaters, single-pass, continuous-tube.....Babcock & Wilcox Co
Heating surface, 6980 sq ft, temperature controlled at 900 F
Economizer, continuous tube, 6780 sq ft.....Babcock & Wilcox Co
Air preheaters, Ljungstrom, 42,800 sq ft each.....Air Preheater Corp
Soot blowers, revolving, valve-in-head.....Diamond Power Specialty Co
Deslaggers, telescopic type.....Diamond Power Specialty Co
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Combustion-control system, premeasured.....Bailey Meter Co

Pulverized-Coal Equipment:

Pulverizers, 2 per boiler, type B, special.....Babcock & Wilcox Co
Pulverizer drive, 100-hp sc motor.....General Electric Co
Weigh scales, conveyor belt, synchronous drive.....Bailey Meter Co
Burners, two per boiler, multiple intertube.....Babcock & Wilcox Co

Coal-Handling Equipment:

Track hoppers and chutes.....Beaumont-Birch Co
Turntable.....American Bridge Co
Skip hoist.....Beaumont-Birch Co
Conveyors.....Beaumont-Birch Co
Structural coal bunker.....R C Mahon Co.

Ash-Handling System:

Ash sluice for slag.....Allen-Sherman-Hoff Co
Sluiceway, hoppers, horizontal-type Hydroseal ash pump, dehydrating, elevated ash-storage tank and rubber-lined recirculating pump
Electrostatic precipitator, vertical-flow type.....Research Corp
Fly-ash ram.....Allen-Sherman-Hoff Co

Draft Equipment:

Induced-draft fans, one twin fan per boiler.....Prat-Daniel Corp
Hydraulic couplings, 2 per fan.....American Blower Corp
Drive, 300-hp sc motor.....General Electric Co
Forced-draft fans, 2 per blr, double-inlet....Green Fuel Economizer Co
Hydraulic couplings.....American Blower Corp
Drive, 100-hp, sc motor.....General Electric Co

Structural Construction:

Architects.....Bowd-Munson Co
Excavation and foundations.....Christman-Lansing Co
Trackwork.....Jarvis Engrg Co
Structural steel.....R C Mahon Co
Superstructure.....Reniger Construction Co
Discharge tunnel and retaining walls.....Fry & Kain
Turbine foundations.....Reniger Construction Co
Miscellaneous platforms, etc.....Allied Steel & Conveyor, Inc
Floor grating, Gary copper-quad.....Standard Steel Springs Co
Glass blocks.....Pittsburgh-Corning Corp
Common brick.....Young Bros & Daley
Salt-glazed brick (through Briggs Co).....Stark Brick Co
Granite.....Sauk Rapids Granite Co
Indiana limestone.....Roy D Beard Cutstone Co
Ventilators, integral-fan type.....H H Robertson Co
Sanacoustic ceilings.....Johns-Manville Sales Corp
Bronze door.....Ellison Bronze Co
Roof and temporary siding.....Porete Mfg Co
Steel sash.....Vento Steel Products Co
Crane doors.....Truscon Steel Co

Boiler-Feed System:

Boiler-feed pumps, 3, double-suction.....Allis-Chalmers Mfg Co
655-gpm, 5-stage, centrifugal
Drive, 600-hp, sc motors.....Allis-Chalmers Mfg Co
Triplex boiler-feed pump, vertical.....Aldrich Pump Co
4-in. x 10-in., 60,000 lb per hr
Hydraulic coupling.....American Blower Co
Drive, 100-hp sc motor.....Allis-Chalmers Mfg Co
Closed feedwater heaters, 2, with drain coolers.....Alco Products, Inc
Heat exchanger, water-to-water type.....Alco Products, Inc
Direct-contact heaters, 2, jet type.....Foster Wheeler Corp
Direct-contact heaters, 2 rain type.....Foster Wheeler Corp
Vent condensers, four, tubular type.....Foster Wheeler Corp
Condensate pumps, 2, four section.....Foster Wheeler Corp
Makeup evaporator and condenser.....Alco Products, Inc
Evaporator drain pump, single-stage.....Jennings Centrifugal Pump Co

Generating Equipment:

Turbine, 25,000-kw, 3600-rpm, condensing.....Allis-Chalmers Mfg Co
Reaction type, tandem-compound, 825-lb, 900-F
Generator, 31,250 kva, 0.8 pf, hyd cooled.....Allis-Chalmers Mfg Co
3-phase, 60-cycle, with 125-kw geared exciter and pilot exciter
Backpressure turbine, 4000-kw, 3600-rpm.....Allis-Chalmers Mfg Co
825-lb, 900-F, 225-lb backpressure with 4160-volt, 3-phase, 60-cycle, 0.8 pf. air-cooled generator, direct-connected exciter
Generator air coolers.....Griscom-Russell Co
Backpressure turbine, 2500-kw, 3600-rpm.....Allis-Chalmers Mfg Co
Existing unit with 4160-volt air-cooled generator
Condenser, two-pass, 23,500 sq ft.....C H Wheeler Mfg Co
⅞-in., 18 Bwg, admiralty tubes. Spring mounted. Copper-bearing-steel deaerating hotwell, 6750-gal, capacity, 3-stage steam-jet air ejector and 4-in. single-stage exhauster
Circulating-water pumps, two 30/24 vertical.....C H Wheeler Mfg Co
150-hp, 450-rpm sc motor drive
Intake screen, 84-in. traveling.....Link-Belt Co

Evaporator Feed-Treating Equipment:

Sedimentation tank, hot lime-soda process.....Cochrane Corp
300,000 lb per hr, deaerating tank, 18-ft diameter, 36-ft high
Raw-water suction strainer.....Andale Co
River-water makeup pumps.....Dean Bros
Filters, 3, 90,000 lb per hr each, steam agitated.....Cochrane Corp
Evaporator-feed and miscellaneous pumps.....Dean Bros
Evaporators, 2, 130,000 lb per hr, single effect.....Foster Wheeler Corp
Horizontal submerged coils, supported on internal carriage
Evaporator preheaters, 2, closed type.....Foster Wheeler Corp
Chemical feed equipment.....Cochrane Corp
Sodium-aluminate tank, chemical pump, phosphate tank and duplex pump, lime-feeder tank and 2 open-impeller chemical pumps. One backwash pump. Soda-ash feeder tank and 2 pumps
Desuperheater stations, 2.....Bailey Meter Co

Piping System:

Piping contractor.....National Valve & Mfg Co
Pipe insulation (through Murphy Supply Co)..Johns-Manville Sales Corp

Electrical Equipment:

Main control boards, 13.2-kv and 4160-v.....General Electric Co
Switchgear, 13,200, 4160 and 460 volt.....General Electric Co
Station-service pyranol transformer.....General Electric Co
Electric wiring and switchgear contractor.....Hartzel & Buehler
Exciter mg set, spare.....Allis-Chalmers Mfg Co
Storage battery.....Electric Storage Battery Co

Miscellaneous:

Air compressor.....Sullivan Machinery Co
Tanks, lubricating-oil and water.....Buffalo Tank Corp
Tanks, fuel-oil storage.....Graver Tank & Mfg Co
District-heating-steam control panel.....Energy Control Corp
Crosley, Brown and Bristol instruments
Turbine-room cranes, 85/10 ton, and 15 ton.....Whiting Corp
Chlorinating system.....Wallace & Tiernan Products Co
Boiler control, gage and meter boards.....Bailey Meter Co

bine is entirely separate from district-heating steam evaporators. Common pretreatment equipment, however, supplies both evaporators. Softened water enters a raw-water preheater through a vent condenser. It is brought to temperature by steam from the evaporator and then vaporized by steam from the No. 3 bleed point. The evaporator condenser is in the feedwater circuit between the 3rd- and 4th-stage heaters. Makeup is trapped from the condenser to a flash tank where it is joined by condensate from the evaporator coils. Flowing to a receiver, the combined condensate is elevated to No. 3 heater which also serves as boiler-feed tank.

Condenser circulating water comes from the adjacent Grand River through a single traveling screen. Circulating pumps are below river level in a dry well; since they are submerged, priming is unnecessary. Vertical shafts connect with the motors on the floor above. Discharge piping leads to a concrete tunnel along the river bank which also serves as a retaining wall. River flow at this point is sluggish, being above a dam used for hydro power. Provision for chlorination is included.

Heating-System Operation

The cycle for the heating-system turbines has been kept separate from that of the main power-generating unit because of the seasonal character of the load, and also because, even in winter, heating load reaches its peak during morning hours while electric loads increase later in the day. All byproduct power is, of course, utilized in the electrical system, but operation of the evaporators and feed system is much simplified by the separate circuits. However, provision is made for combining the operations if necessary.

High-pressure steam at 825 lb, 900 F, is supplied by one of the boilers to a new 4000-kw, 3600-rpm backpressure turbine exhausting at about 200 lb to two 130,000-lb-per-hr evaporators. All condensate from the coils of the latter is eventually returned to the boiler, forming a closed circuit. Before the hot evaporator condensate can be successfully handled by the boiler-feed pumps (the same four that serve the main unit), it must be cooled sufficiently to avoid flashing in the pump. This is accomplished in a water-to-water heat exchanger (center of Fig. 7). After cooling, the condensate enters a boiler-feed storage tank. Then it is pumped back through the heat exchanger where it recovers the heat lost just before entering the pump. Leaving the heat exchanger at about 350 F, the feedwater is piped directly to the economizer.

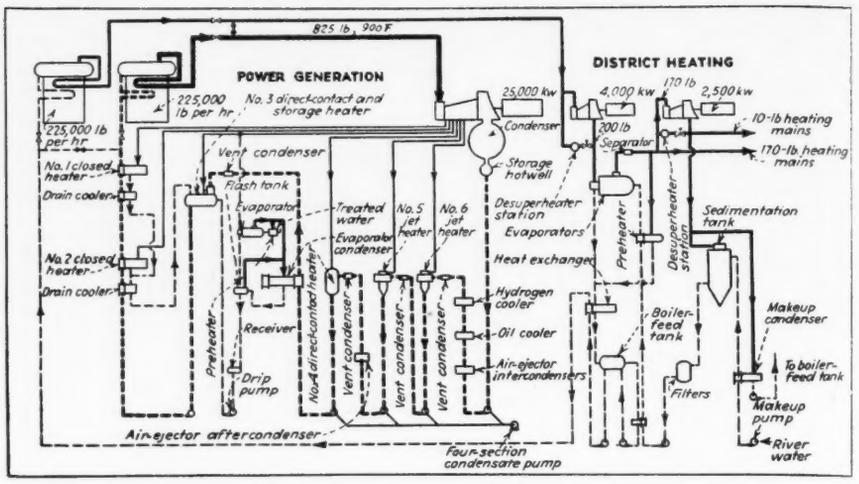


Fig. 8—Flow diagram of 6-stage feed-heating cycle for power generation. Heating-steam cycle can be operated independently making use, however, of common feed pumps

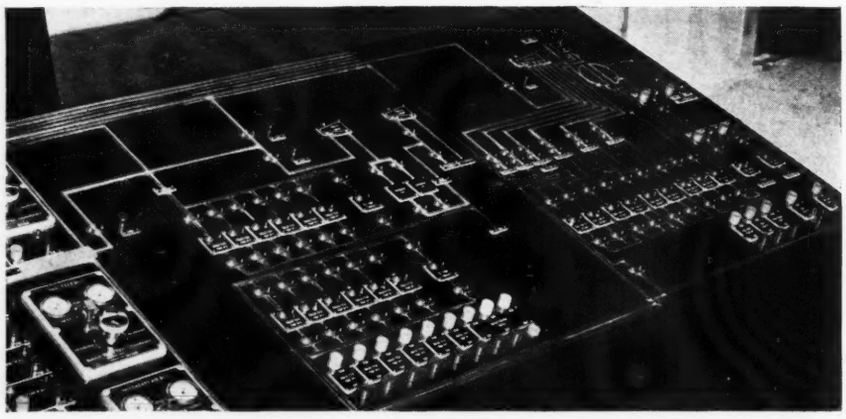


Fig. 9—Section of combustion-control panel shows schematic flow diagram of entire plant and position of all valves. Boiler-gage panels, combustion control, generator and district-heating panels are in semi-enclosed space between boiler and turbine rooms

Steam produced by the evaporators at 170 lb goes partly to the high-pressure heating mains and partly to an existing 2500-kw turbine-generator unit exhausting at 10 lb to low-pressure mains. All steam to the heating system is metered, the quantities and conditions being remotely indicated and recorded on a separate panel in the control room.

Water supply for the evaporators is pumped from the Grand River to a 300,000-lb-per-hr hot-process softener (sedimentation tank), and then through three 90,000-lb-per-hr filters. Before entering the evaporators, the water is preheated in a separate heater supplied with 170-lb evaporator steam. Sedimentations tank receives its steam supply from the 10-lb header.

Two reducing-valve and desuperheater stations, one from 825 to 200 lb and the other from 170 to 10 lb, protect the heating-steam supply from turbine outage as well as provide extra capacity for short-time peak loads.

Interesting to operators is the single-line piping panel, Fig. 9, which keeps the operating conditions of the various steam and water circuits constantly posted in the control room. Valve position is shown by red and green lights.

One feature of the 25,000-kw turbine-generator is its ability to carry overload up to 31,250 kw at 0.8 power factor by increasing hydrogen pressure in the generator casing from the normal few ounces to about 9 lb g. By increasing the density of the hydrogen, greater cooling effect is achieved, and, although hydrogen leakage will be considerably increased for the duration of the overload conditions, about 25% added capacity can be supplied in emergency at no appreciable increase in investment.

Design and construction of the new plant has been carried out by Burns and Roe, Inc, engineering consultants, New York, N Y. The architectural treatment was worked out by Bowd-Munson Co of Lansing, Mich. The plant was built for the Board of Water & Electric Light Commissioners of the City of Lansing, headed by Mr Hugo B Lundberg, president. Mr Otto E Eckert is general manager for this board.

LETTERS FROM A TURBINE SPECIALIST

No. 2—On Single-Phase Operation of 3-Phase Generators

By F S KOHL and W W KUYPER
General Electric Co, Lynn, Mass.

Turbine Specialist
District Office

Dear Mr Specialist:

From time to time I hear the statement that it is serious business to carry single-phase loads on 3-phase generators. Just yesterday, three or four of us here were talking about this and not one of us knew why. We couldn't see what was wrong with such operation, provided full-load current in any phase was not exceeded.

I would appreciate your dropping me a note explaining what it is all about in not too-technical terms.

Very truly yours,
Engineer

Dear Mr Engineer:

You may be surprised to learn that it is the possibility of damage to the generator *rotor* rather than to the phase coils that limits single-phase loading of 3-phase generators.

Before explaining this, let me point out that single-phase loading is the extreme case of unbalanced 3-phase loading. In addition, operation of the generator out of synchronism, the existence of different power factor in different phases, and the closing of the circuit on its bus while the machine is stationary, present similar difficulties. Failure of a switch to open or close all three phases, or its failure to clear a single-phase fault, or unequal distribution of single-phase plant load will also give unbalanced phase loading.

So much for that—here's what happens to the rotor and why.

Under any of these operating conditions, high circulating currents tend to flow in the surface of the rotor. The paths followed by these currents, Fig. 1, are of high resistance and it is the resultant heating that causes trouble.

Whether the rotor is solidly forged or laminated, currents near the ends (*A,B,C,D* in Fig. 1) are of high density and are cutting across the high-resistance joints between the wedges and teeth, Fig. 2. Heating is excessive, damaging insulation of the top turns of the rotor coils. It may even soften the metal at these points. Stresses beyond limits of the materials may be produced by such temperature differences.

Currents flowing axially (*E* and *F*, Fig. 1) cause little trouble in solid rotor forgings, as the teeth provide a continuous path with no localized regions of high resistance. In laminated rotors, the currents tend to flow lengthwise down the wedges and may cause excessive heating in them. At points where there are gaps in the wedges, the currents bypass the opening through the adjacent punchings, these points having a relatively high localized resistance. The heating at these points may be enough to cause melting. You can see serious troubles may result.

Now let's see what causes these circulating currents. When one speaks of a generator's magnetic field, he usually thinks of the field created by the direct current flowing through the rotor coils. The important point to remember is that the alternating currents on the stator windings also produce a field. Now, if the 3-phase currents are balanced, this field is rotating in the same direction as the rotor and at the same speed. The flux of this magnetic field and the rotor are in "synchronism" and stationary with respect to each other. And since the rotor is stationary with respect to the flux, no voltages or currents are induced in it.

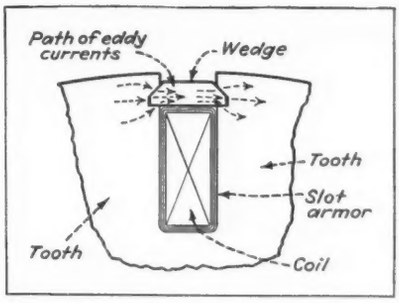


Fig. 2—Contact between tooth and wedge offers high resistance to induced currents; local heating results

Under unbalanced 3-phase operation, however, the flux is not stationary with respect to the rotor and damaging circulating currents are induced. Imagine the field in two parts, one part in synchronism with the rotor, similar to the magnetic field described above, and the other rotating at the same speed but in *the opposite direction*. The flux moving in the opposite direction is moving at twice synchronous speed relative to the rotor. It induces voltages and currents of twice line frequency in any path the rotor provides.

Please bear in mind that, while unbalanced phase loading may result in serious damage, it is a fault that can be easily prevented. By distributing single-phase loads equally on each of the three phases, the generator's load can be balanced properly. Care in operation and adequate switching and protective devices will practically eliminate the possibility of accidents leading to unbalanced loads.

There are certain limits of unbalance that may be carried safely. For single-phase loads, this limit is about 25% of normal current.

Does this clear up the question in your mind? If not, I'll be glad to discuss it with you during my next visit.

Sincerely yours,
Turbine Specialist

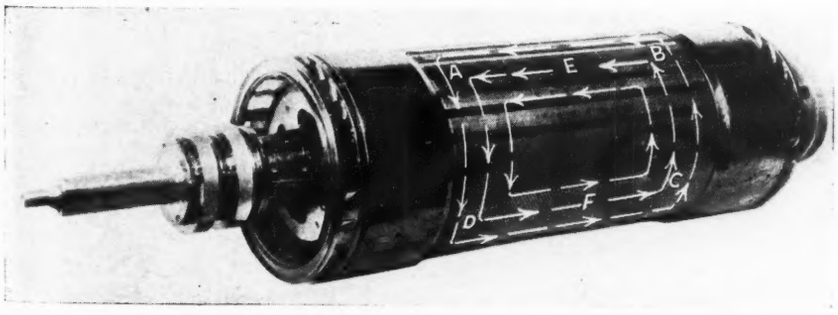


Fig. 1—Induced currents flow in paths on the rotor surface

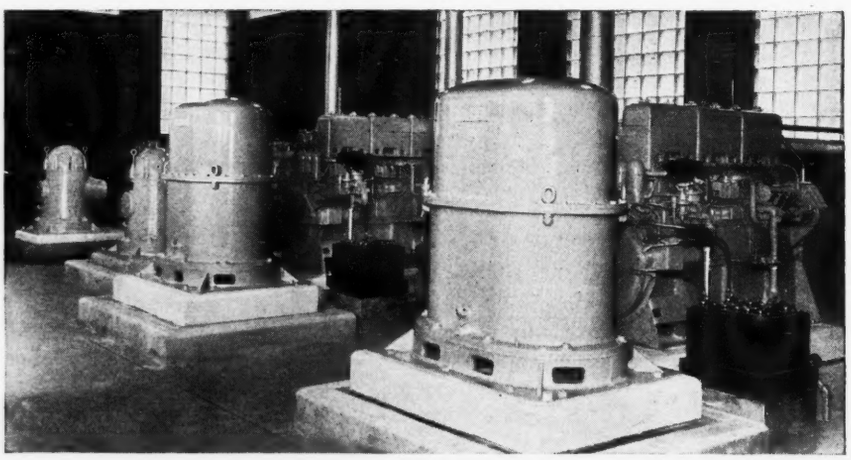
Pumps Against the River

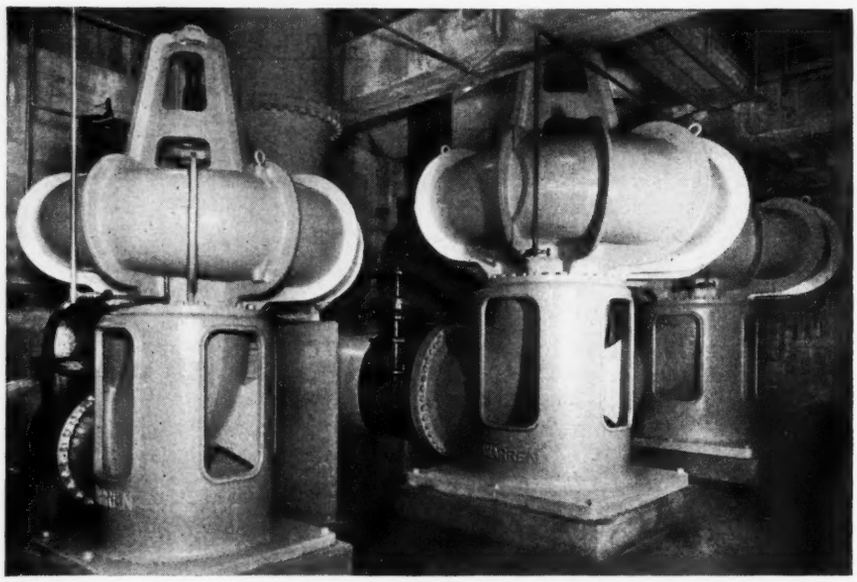
Springfield, Mass., installs fourteen gasoline-engine- and diesel-driven pumps, of 480,000,000 gpd total capacity, to handle sewage and drainage during floods of Connecticut River

FLOODS and more floods have been the lot of cities along the Connecticut River, with Springfield, Mass., no exception. In the fall of 1927, the lower part of the city was flooded and again in 1936, a more extended area was inundated. Since then, the U. S. Engineer Corps, PWA and the city have cooperated in an anti-flood construction program.

Because streets of lower Springfield are below flood-water level, the U. S. Engineer Corps is constructing a system of dykes to keep water within the river banks during any possible flood, based upon an exhaustive study of past floods and a survey of local drainage area. Dykes can keep the water from coming over the banks into the city, but something was needed to keep water from backing up through the sewers and overflowing into the low-level district. The city and PWA are taking care of this end of the job.

Sewage and stormwater from the lower section of the city is normally discharged directly into the Connecticut. When the river rises above a predetermined level, backwater gates in the various outfall sewers will be closed and the sewage and stormwater flow will be diverted to four pumping stations, where it will be lifted and discharged against the head resulting from floor water in the river.





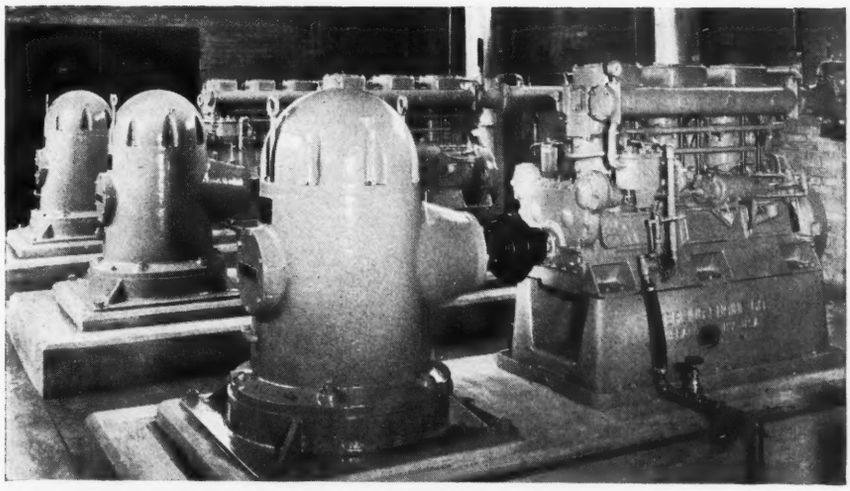
Two 425-hp and two 180-hp gasoline engines in Phelps Ave Station drive two 75-mgd and two 30-mdg vertical-shaft, mixed-flow centrifugals, through right-angle gears

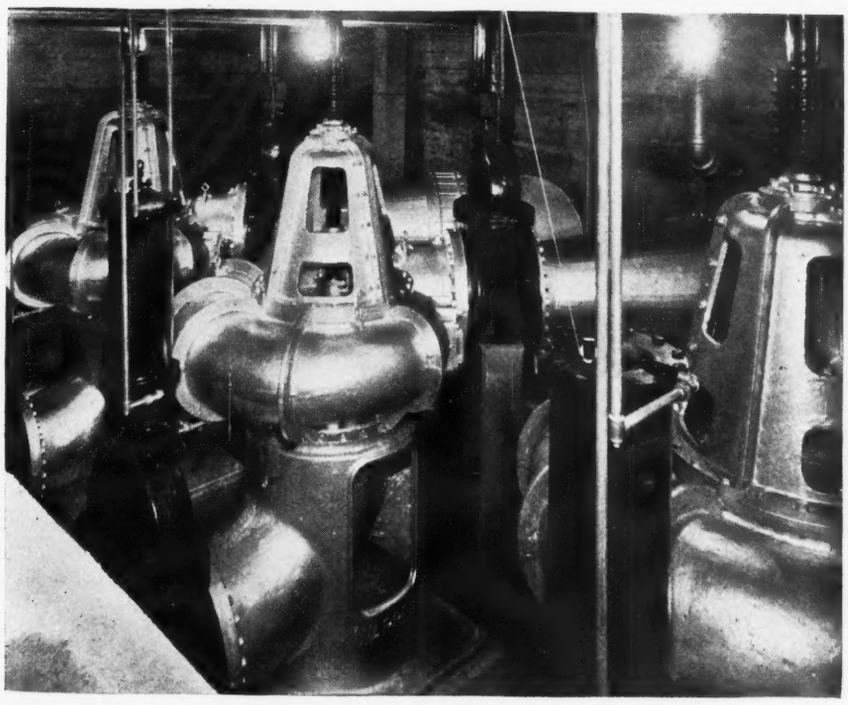
Four Pumping Plants

There are four pumping plants: Phelps Ave with two 75,000,000-gpd and two 30,000,000-gpd pumps; Clinton St and Union St stations, each with three 30,000,000-gpd pumps; and York St station with two 30,000,000- and two 15,000,000-gpd pumps. All these pumps operate under heads of 5 to 25 ft. They have cast-iron cases and impellers, are vertical with bottom suction and side discharge, and each is supported on a cast-iron base into which the suction elbow is cast.

The pumps are in dry pits, from where suction connections are made into the sides of the receiving basins. These connections are made with a section of horizontal pipe containing a hydraulically operated gate valve. A similar arrangement connects the discharge of the pumps into a common discharge conduit leading to the outlet sewer. All valves and sluice gates are operated by city-water pressure from a remote-control table on the engine-room floor. By closing discharge and suction valves, a pump can be drained and inspected at any time, through manholes in the suction elbow and in the volute casing.

Discharge and suction nozzles are the same size on each pump, being 48 in. on the largest pumps, 30 in. on the intermediate size and 20 in. on the small units. Impellers are non-clogging, mixed-flow, 3-vane, closed, to handle raw sewage if necessary. Impellers on the 75-mgd pumps will pass a solid sphere 9 in. in diameter, on the 30-mgd pumps a 6-in. sphere and on the 15-mgd pumps a 4-in. sphere. Nor-





Three 180-hp, 1200-rpm gasoline engines in Clinton St Station (top) drive three 30-mgd centrifugal pumps through right-angle gears. Same setup at Union St Station (below) showing pumps in dry pit

mally, sewage and storm water will run through traveling screens having bars spaced 1½ in. apart.

Renewable bronze sealing rings are provided on both the impeller and casing of each pump. These rings can be lubricated with city water, from an elevated tank in each plant, so that the pumps can operate empty indefinitely. Sealing water for the stuffing-box lantern rings is also taken from this tank.

These pumping plants are for emergency service and will not operate more than once or twice a year, and then for only a few days at a time. When they are needed, however, they must be 100% reliable, and power units must be self-sufficient and independent of outside influences.

Insulation on electric motors standing idle for long periods tends to deteriorate, and a standby charge must be paid for purchased power whether or not it is used. Also, an outside power source may be seriously crippled during a disastrous flood, as past experience has shown. Gasoline engines require little attention when shut down, and are easily started; furthermore, fuel is easily stored and can be handled in coldest weather without heating. For these reasons, gasoline engines drive all pumps except two, which are powered with diesels.

On the largest pumps the engines are rated 425 hp, on the intermediate pumps 180 hp, and on the small pumps 100 hp. All engines operate at 1200 rpm and connect to the pumps through heavy-duty right-angle gears. Engine and gears are mounted as a unit, with a flexible coupling between, on a reinforced-concrete-slab foundation. This foundation rests in a pit, formed by concrete curbs on the ground floor of the station, on a vibration-isolation cork plate 2 in. thick. The foundation is also isolated from the curbs with 2 in. of the same material, so as to form a continuous lining between the station floor and engine foundation.

Cooling-Water System

Cooling water for the engines is taken from a 300-gal. elevated storage tank in the station. Each engine has a master valve to shut off cooling water without interfering with flow-adjustment valves to different parts of the cooling system.

The ignition system is so interlocked with the cooling-water valve that one cannot start an engine without first turning on the cooling water. Thermometers on each section of the cooling system, an alarm and an automatic stop, protect each engine against operating with insufficient cooling water. The alarm sounds when the cooling-water temperature reaches 150 F and if an engine's cooling-water temperature reaches 175 F, the unit is shut down automatically.

Each engine has an air-intake filter, exhaust silencer and starting motor. Engines on the 30- and 15-mgd pumps have one 12-volt starting motor and those on the 75-mgd pumps have two 12-volt starting motors. Each pumping station has two 6-cell, 12-volt, lead storage batteries that are kept charged by Tungar rectifiers. Battery chargers are connected to the line each day by a time switch and are disconnected when the battery is charged, by a sensitive voltage relay.

Starting Bus

A single heavy starting bus runs from the batteries, below the engine room floor and directly under the starting motors on the engines. In the Phelps Ave station, this bus is a 1-in. copper pipe insulated with tape and in all other plants ¾-in. pipe. From the bus, a vertical connection of No. 00 copper wire runs to each starting motor, except on the large engines where the starting motors are connected to the bus with two No. 00 wires.

Each battery has adequate capacity when charged to turn over and start each pumping unit in the station four times in succession with pumps full of water, with the suction valve closed or open, when the units and battery are

at a temperature of 35 F. In the Phelps Ave station, the battery can operate simultaneously the two starting motors on a 75-mgd unit.

The two 15-mgd pumps in the York St station will deliver raw sewage from the lower-level sewers of the city to a new treatment plant now being built on an island in the Connecticut River. They will also discharge sewage into the outflow sewer during high floods, as will the other pumps. Consequently, these two pumps will be in continuous service. For this reason, each pump is driven at 560 rpm by a 100-hp, 4-cycle, 3-cylinder, 600-rpm diesel, through a right-angle gear. These engines will operate on oil until the sewage-treatment plant is in operation; they are designed for conversion to sewage-sludge digester gas of 600 Btu heat content per cu ft.

Each engine and gear is mounted as a unit, with a flexible coupling between, on a reinforced-concrete slab foundation supported on special vibration absorbing springs to completely isolate the foundation from the building.

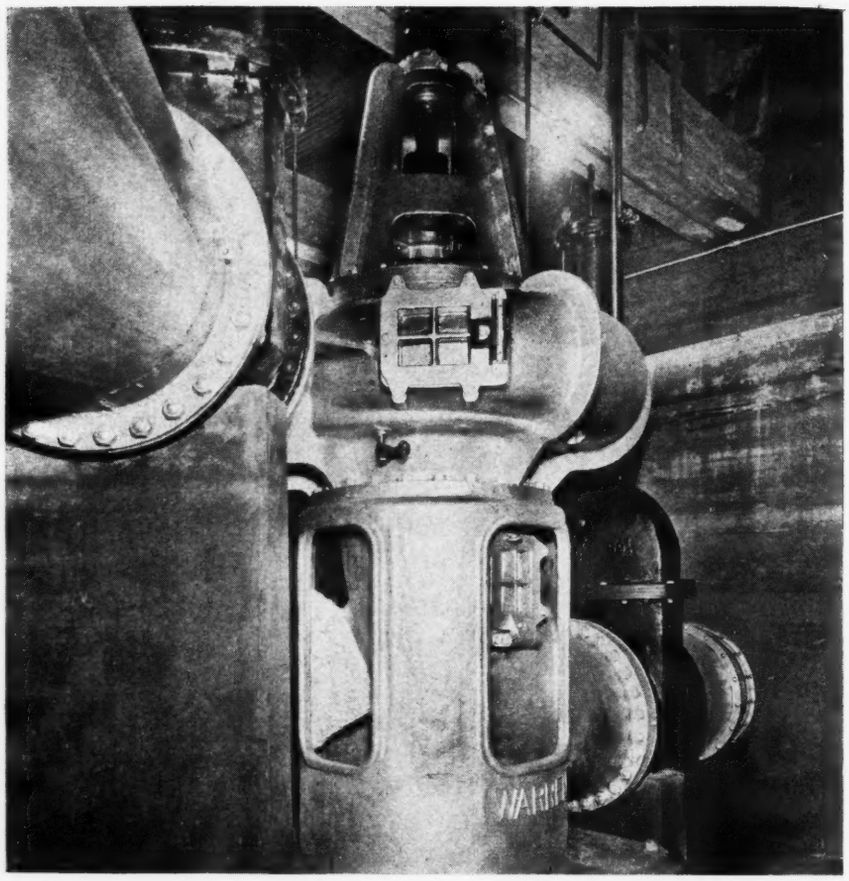
Engine Governors

A governor on each engine will maintain constant speed within 5% from no load to full load for any speed setting from maximum to 60% of maximum. A hand control permits varying the speed setting of the governor over that range.

Starting equipment includes two 8.5-cu-ft air receivers and a motor-driven air compressor rated 6.5 cu ft of free air per min when discharging at a pressure of 250 lb per sq in.

These stations, being for emergency, can not depend for any essential service from the outside. Experience has shown that no electric power system can be depended upon 100%. To guard against an interruption to the outside power supply used for auxiliary purposes, each station has a gasoline-engine-driven alternator with direct-connected exciter. These units are rated 15 kw, 0.8 pf, 240 volts, 3 phase, 60 cycles. If outside power fails, they can supply the needs for station lighting, battery charging, operating auxiliary pumps and other small equipment. Two 5-kva transformers provide 115 volts for lighting and other service. A transfer switch and switchboard permits quick change over from the regular outside service to emergency.

The plants were designed and built under the supervision of Cornelius W Phillips, superintendent of Springfield's Department of Streets and Engineering. Metcalf & Eddy Co were the designing engineers and White & Burke Co the supervising engineers. Buildings were constructed by Fred T Ley Co, mechanical equipment furnished and installed by Warren Steam Pump Co, Inc, with Ralph P Hall, Inc, as subcontractors on installation work of mechanical equipment and Thomas F Touhy as subcontractor on electrical equipment.



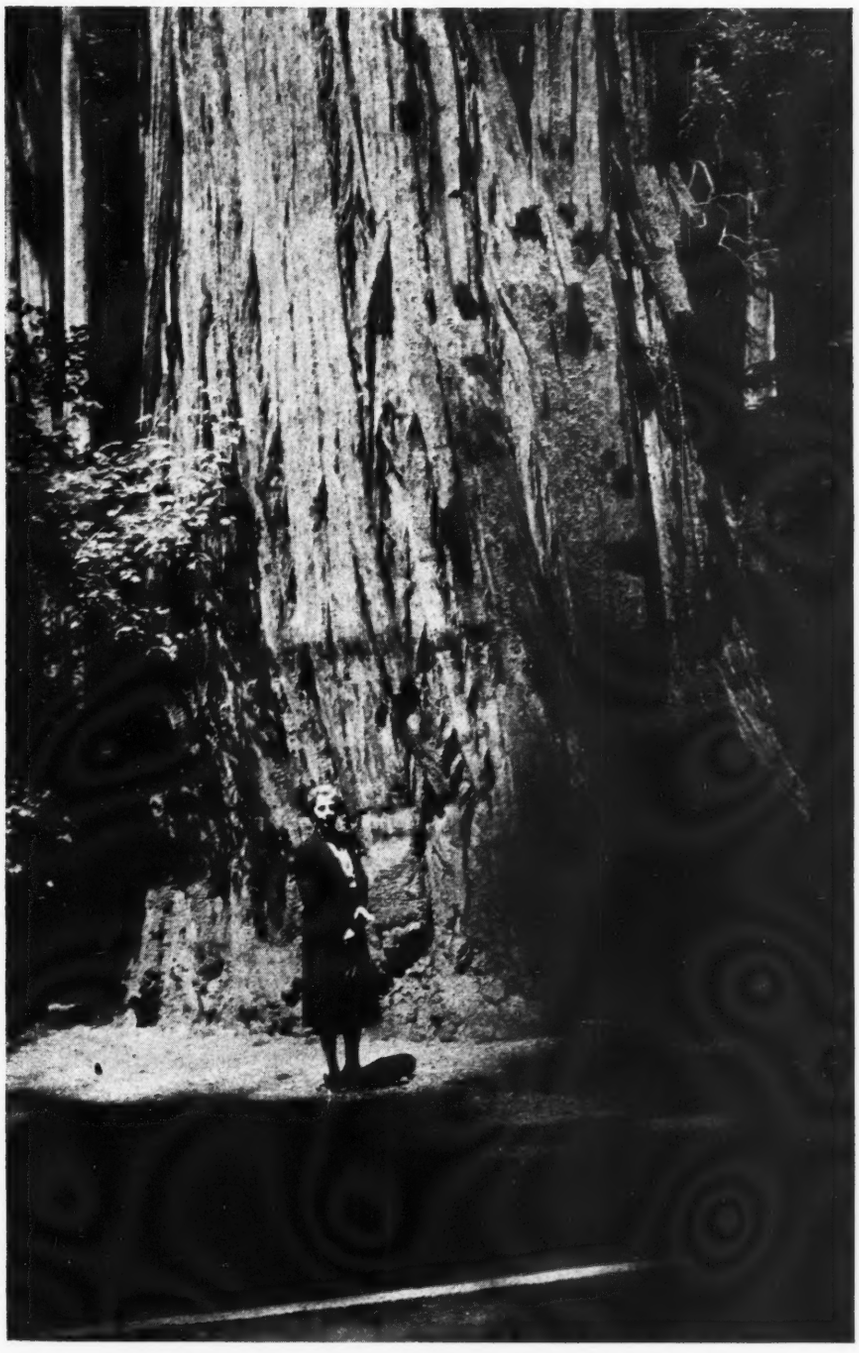
Suction connection (lower right) and discharge connection (upper left) to one of the three 30-mgd pumps in Clinton St Station

Principal New Pumping-Plant Equipment, Springfield, Mass.

Main pumps, 14.....Warren Steam Pump Co, Inc
Vertical-shaft, mixed-flow, centrifugals with 3-vane impellers, cast-iron casings and impellers. Phelps Ave Station—two 75-mgd (52,000 gpm), 250-rpm, and two 30-mgd (21,000 gpm) 390-rpm, gasoline-engine-driven; Clinton St and Union St Stations—each, three 30-mgd (21,000 gpm), 390-rpm, gasoline-engine-driven; York St Station—two 30-mgd 21,000 gpm), 390-rpm, gasoline-engine-driven and two 15-mgd (10,500 gpm), 560-rpm, diesel-driven. Head range 5 to 25 ft
Gasoline engines driving main pumps.....Sterling Engine Co
Two 425-hp, ten 180-hp, all 1200-rpm, through right-angle gears
Diesel engines driving two 15-mgd main pumps.....Superior Engine Co
100-hp, 3-cyl, 4-cycle, 600-rpm
Right-angle gears, 14.....Farrel-Birmingham Co, Inc
Flexible couplings.....{Falk Corp / Poole Engrg Co}
Vibration absorption cork for gasoline engines.....Armstrong Cork Co
Spring mountings for diesel engines.....Carl Hussman, Inc
Suction and discharge gate valves, 28.....Chapman Valve Mfg Co
Gate-valve hydraulic control.....International Filter Co
Traveling screens.....Chain Belt Co
Emergency gasoline-engine driven power units....Fairbanks, Morse & Co
Four 15-kw, 0.8-pf, 240-volt, 1200-rpm, 60-cycle, 3-phase, with direct-connected exciters
Switchboard for emergency power units..Westinghouse Elect & Mfg Co
Diesel lubricating-oil purifier.....Goulds Pumps, Inc
Engine exhaust silencers.....Maxim Silencer Co
Pipe couplings.....Dresser Mfg Co
Unwatering pumps.....Lawrence Pump Co
Sump pumps.....Pemberthy Injector Co
Storage batteries.....Electric Storage Battery Co
Battery chargers.....General Electric Co
Sewage-level indicator and recorders.....Bristol Co
Air compressor.....Quincy Compressor Co
Traveling chain-hoists.....Wright Mfg Co Division
Heating plants.....American Radiator Co
Unit heaters.....Herman Nelson Mfg Co
Ventilating fans.....American Blower Co

An Engineer's Northwest Passage

Up the West Coast—through Oregon and Washington to British Columbia—business men chase timber and fish, engineers chase business men, and Editor Swain chases engineers. This article completes the diary of his Western trip



California has many trees bigger than this giant redwood

IT'S HARD TO LEAVE California, but there's much compensation in the green country to the north. On Friday night, July 14, I say good-bye to John Herzog, my last contact in San Francisco. I have round-trip train ticket, but take the bus, anyway, to see some more of those big trees over the week-end.

It may be a long way to Tipperary, but it's further from San Francisco to Portland—in fact as far as from Charleston, S. C., to New York. All day long I roll through wonderful redwood country to Eureka—then most of Sunday along the rocky Pacific coast to Grant's Pass, just over the Oregon line. The Southern Pacific sleeper lands me in Portland Monday morning.

Portland is a neat little city of 335,000. Parks and home plots are full of roses and green shrubs. Though a hundred miles from the ocean, this is a seaport, as well as a lumber center, and it's not far from the great fisheries of the Columbia River. But the Douglas fir, more than any other one thing, is the foundation of Portland's prosperity.

Bonneville Dam

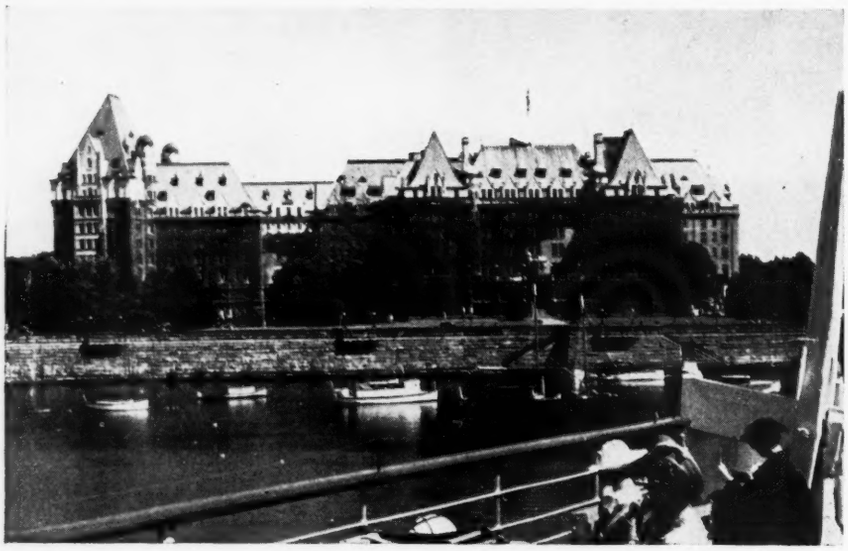
On Tuesday, July 18, I drive about 40 miles up the Columbia River to Bonneville Dam. The Bonneville structure is not as monumental as Boulder Dam, but it is important economically (in a good or bad sense, according to how you look at it), and the Columbia River below the Dam is really majestic.

I understand that the Bonneville project cost about $55,000,000 altogether. The Dam forms a deep slackwater pool 50 miles inland to The Dalles, Oregon. This Dam can produce a lot of power, whose consumption, in a region already blessed with a surplus of this commodity, will be something for somebody to worry about.

Back in Portland again, I decide it's time to get some sawdust in my shoes; climb the young mountain of hog fuel that towers above Station L, Portland Gas & Electric Co. Straight across the Willamette River is another fir-fired steam plant (Northwestern Electric Co), and another mountain of wood waste to feed it.

With the cooperation of Walter Brenton, chief engineer, and C E Coryea, mechanical engineer, I wander all

Here comes Seattle!



Empress, queenly hotel, dominates harbor of Victoria, B. C.

through Station L, world's largest hog-fuel fired central station—77,500 kw.

Some of the hog fuel comes from the lumber mill next door, some by barge from distant lumber plants via the Columbia and Willamette rivers. Bought by the "unit" (200 cu ft), the hog fuel circulates around the plant in a drag conveyor and is chuted to conical fuel piles on water-cooled grates in Dutch ovens. Each of the big boilers in this plant is fired by eight Dutch ovens. You'll find the story in November POWER.

Other interesting contacts in Portland include F W Horstkotte, consulting engineer (lumber and paper mills, etc), and Lee C Baltzell, supervising engineer for Pacific Indemnity.

Leaving Portland Friday morning, July 21, I stop off at Longview on the Columbia River, fifty miles from the Pacific. If Longview ever needs a booster, they can count me in. In the course of years I see scores of industrial towns, but few to beat this place —a completely planned community, founded in 1923.

Here are a few statistics: 15,000 population, eight hotels (including one of first rank), two modern hospitals, public library, YMCA, wonderful high-school building, junior college, 160 acres of parks and playgrounds, fine country club, a $6,000,000 bridge, deep water and big docks to load ocean ships, wonderful river and mountain view, fine fishing and hunting, plus the world's two largest lumber mills (Long Bell Lumber Co and Weyerhaeuser Co). [Note: The editor owns no real estate in Longview.]

Having time for only one plant visit, I select Weyerhaeuser, and call on S B Lewis, assistant manager of the Lumber Division, A A Gregory, chief engineer of the power plant, and L R Guthrie, assistant chief engineer.

Guthrie shows me all over the lumber mill and its fine power plant (with nine hog-fuel boilers and two 9,500-kva condensing turbines bleeding steam to the pulp mill and dry kilns at 135 lb.) Lumber capacity in normal operation is 1,650,000 bd ft daily. I don't think this plant is surpassed by any lumber mill in the world in quality of equipment, in layout, in supervisory skill, or in efficiency of operation. Later I hope we can give you more detailed power information about Weyerhaeuser.

Next day I work up to Shelton on the Olympic Peninsula. Have a pleasant chat with Mr Mackay, manager of the Joint Power Operation, and with Mr McKenzie, engineer of the steam department. This jointly owned power plant serves the adjoining mills of the McClearly Timber and Rayonier. High-pressure boiler and turbine are now going in.

From Shelton north, the country gets more and more beautiful. With its rocky coves, woods and green gardens, the lower end of this Olympic Peninsula reminds me a bit of some parts of Maine. Further north the big Olympic mountains dominate the skyline.

Seattle

At Bremerton I leave the bus to ferry across Puget Sound to Seattle. All things considered, this Puget Sound country is (to my taste) the most pleasing I have seen anywhere in America. "It satisfies," as the cigarette ads say.

Seattle is an A-1 town. Wonderful harbor and water front! No city of any size in this country has a finer natural background for cruising, fishing, camping, hunting, mountain climbing and skiing. Mt Ranier and Mt Baker, both over 14,000 ft, are easily reached by automobile. Puget Sound and surrounding waters provide hundreds of miles of protected salt water—innumerable Douglas-fir-clad islands, plus blueberries, raspberries, blackberries, and big salmon itching for the hook. And right out of this scenery come the major industrial raw materials: timber (for lumber, pulp and paper), fish, fruit, mine products.

Among the people I see in Seattle are W L Raymond, executive vice-president of Rayonier, H W Beecher, consulting engineer with long experience in the design of hog-fuel plants, Mr Sears, general superintendent of power and water supply for Puget Sound Power & Light Co. On the more personal side, I should mention a visit to a delightful home on Lake Washington, Seattle's fresh water playground.

A lot of people have heard about

Seattle's Department of Lighting, familiarly known as "City Light," built up under the spectacular leadership of J D Ross, who died early this year. As a unique combination of public relations and civic recreational work, City Light has established an elaborate 2-day tour which Seattle residents and others can enjoy for $4.05 each. I take this tour through the courtesy of Eugene R Hoffman, superintendent of City Light, and Glenn Smith, superintendent of outside construction, but my immediate host is George Meagher, superintendent of shops. With Mrs Meagher and daughter, he drives my wife and me a hundred miles to Rockport, Wash., where the real show starts.

We board a little mountain train which runs up the Skagit River 23 miles to Gorge plant (75,000 hp). There we spent the night in the bunkhouse, after a good supper, a walk through a primeval forest, a loudspeaker concert from the facing mountain cliff and a visit to the beautifully illuminated Ladder Falls.

Diablo Dam

In the morning, after a good sleep and a hearty country breakfast, we board the electric train for Diablo Power Plant (now 160,000 hp)—very neat! Then on up to Diablo Dam, a thing of beauty in an Alpine setting of snow-capped mountains. Next we cruise up Diablo Lake from Diablo Dam to Ross Dam, now under construction. This boat trip is something to write home about, but by this time I've run out of adjectives, so won't attempt a description.

The pulling power of this City Light show may be judged by the fact that citizens of Seattle and vicinity are spending about $4000 per week to take the tour. All things considered, it's as interesting as a trip through the Yosemite.

Stanley Rennison, chief engineer of the Empress Hotel, Vancouver's pride and joy

Kenneth Moodie, heating engineer for the Province, surveys Butchart's Gardens

I leave Seattle via C P R Steamship for Victoria, "the most English town" outside of England, uniquely charming little city on the southern tip of Vancouver Island. Victoria is plenty English all right: retired colonels from India, afternoon tea, little baskets of flowers hung from all the street lampposts in town, and that sort of thing.

Among my most pleasant recollections of Victoria are visits with Stanley Rennison, chief engineer of the palatial Empress Hotel; Kenneth Moodie, heating engineer for the provincial Department of Public Works, Arthur Manson, operator of the heating plant in Parliament Building. All three are POWER readers and certainly do the handsome thing by an editor and his wife on the loose. Rennison has a first-class, modern power plant, with steam engines, diesel engine, large laundry, etc. (More data later.)

Vancouver Island, big as England, is Canada pointing south. Straight below it is the Olympic Peninsula, U. S. pointing north. The Olympic Peninsula, extreme northwestern tip of the United States, is a magnificent piece of scenery with its snow-capped Olympic mountains pushing out into the Pacific Ocean.

While in Victoria I ferry 20 miles south across the straits to Port Angeles, nestling rather tightly between the Olympic mountains and the north shore of the peninsula. There I inspect power plants serving pulp and lumber mills and have a very pleasant session with one of the top engineers. At the moment I am not at liberty to give further details, but hope to be able to do so later.

Saturday, July 29, my fourth voyage on Puget Sound, this time from Victoria to Vancouver. The ship weaves among heavily wooded islands with rocky shores. Everywhere are fir-clad shores, with backdrop of mountains. We swing into Vancouver harbor. Here, almost on the edge of civilization, is a city of 300,000 inhabitants, and the $13,000,000 Vancouver Hotel, a truly magnificent and modern establishment with its own steam power plant.

I visit H J Scanlon, chief engineer of the Hudson's Bay Co department store. He has oil-fired boilers with steam engines for winter load. Buys his power in summer and converts it to dc with 275-kw mercury set.

Also visit Frank Hull, chief engineer of Vancouver General Hospital. Hull's hospital setup includes a large

(*Continued on page* 132)

On to Vancouver

What Price Fuel?

What's your cheapest fuel today? And tomorrow? Long-range study based on peace-time conditions indicates fuel oil will increase in price more than coal. War may make the spread even greater

By SAMUEL H BURR*
The Strong-Scott Manufacturing Co

IN many industrial enterprises, variations in fuel cost can make sizeable impressions on net earnings. Plants equipped for burning alternate fuels to take advantage of market conditions have made savings far in excess of any possible last few notches in boiler efficiency. What are the prospects for the future?

Many engineers are under the impression that coal and oil prices go up and down together. Another common idea, securely founded on a day dream, is that there is some cyclic relationship, a regular rotation of periods when coal is cheaper than oil and vice versa. The real relation is much more complex.

A look at the curves below will convince anyone that the price trend of coal is *relatively* stable as compared to that of Bunker C oil. To get comparative curves of the price *trends*, 14,000 Btu was taken as the arbitrary heating value for coal and 147,839 Btu per gal. for oil, the latter figure being computed from fuel-oil values given in the Todd Combustion Equipment Co catalog, Then, the amount of oil to give 28,000,000 Btu (2,000 pounds of 14,000-Btu coal) is 189.3 gal., or approximately 4½ barrels of 42 gal. capacity.

Curve *A* shows the cost of 4½ barrels of Bunker C oil at the refinery plus 20¢ per barrel for tank-wagon delivery. Curve *B* is the refinery price for reference. Coal costs, curve *C*, are the average mine-realization figures published by the Bureau of Mines with an arbitrary freight rate of $2.86 per net ton added. These mine prices are composites for the entire country. A check, curve *D*, shows average wholesale price of mine-run Pocohontas per net ton f.o.b. Norfolk, Va.

Since this chart is a factual one, no adjustments have been made for efficiencies, coal and ash handling, or oil-heating and pumping costs. As it is primarily a comparison of price *trends*, slight variations in Btu values or other factors affecting local costs are of no consequence. Such costs raise or lower the entire curve for one or the other fuel, not seriously affecting the important fact that swings in oil prices are of greater magnitude than those of coal.

The trends of the two coal curves are quite similar, indicating that the price trends for coal are closely uniform for the whole country. The only major deviation is found in 1926 when large exports of seaboard coal during an English strike affected the Pocohontas price.

As compared to Bunker C, coal has shown itself to be a stable commodity, subject to relatively minor fluctuations. The indications are that any percentage increase in the *delivered* price will be small. Even if the f.o.b. mine price were increased 20%, from $1.96 to $2.35, the increase in cost to the purchaser on a $2.86 freight rate would be only 8%.

The outlook for Bunker C, however, is none too bright. It is purely a by-product and, as such, its price is governed closely by the law of supply and

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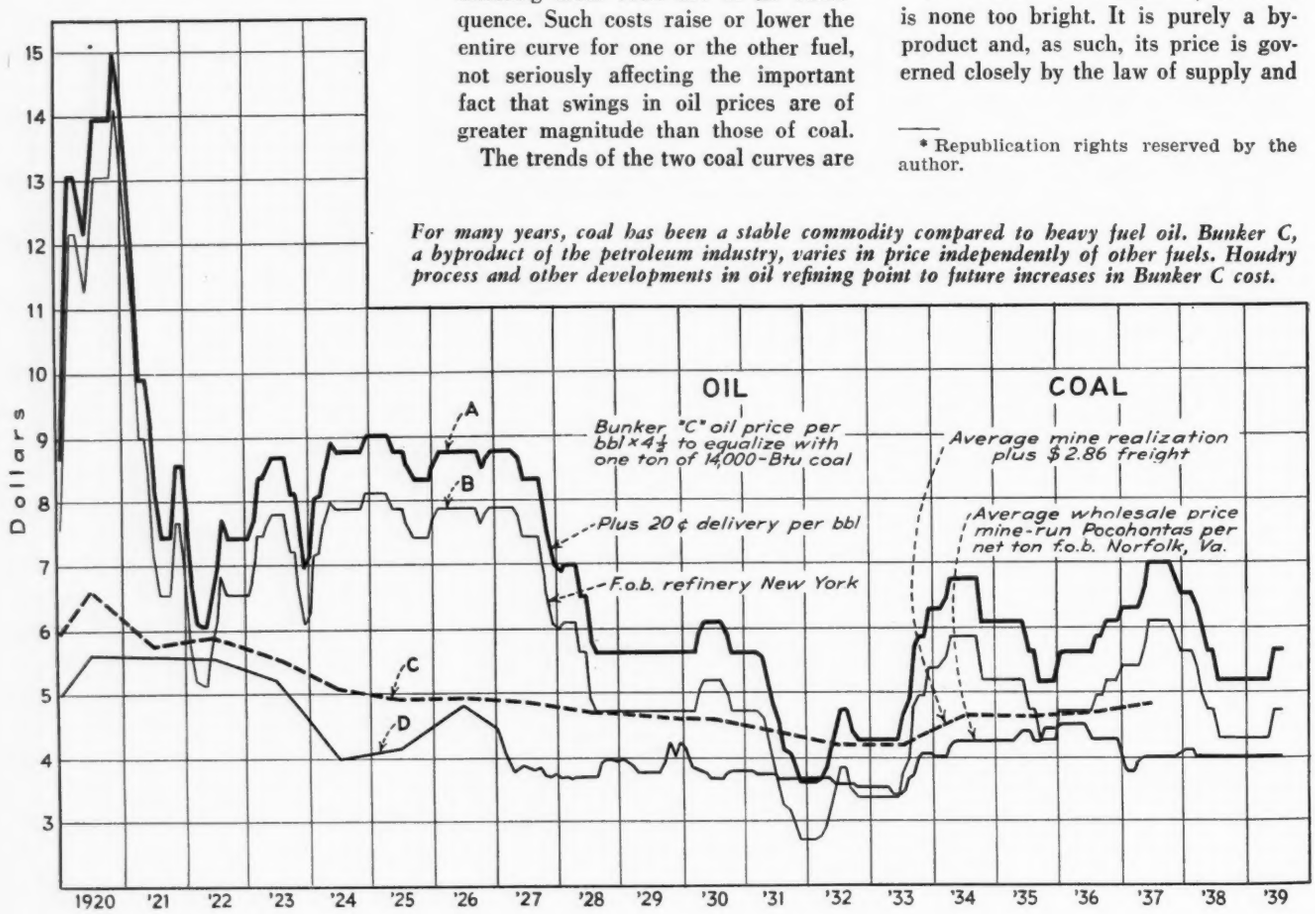
For many years, coal has been a stable commodity compared to heavy fuel oil. Bunker C, a byproduct of the petroleum industry, varies in price independently of other fuels. Houdry process and other developments in oil refining point to future increases in Bunker C cost.



demand. The efficiencies of refinery operations have been increasing rapidly, so that, while gasoline production has increased over 600% during the past 20 years, the percentage of residual fuel oil has dropped from 42% to 25% of the crude. Catalytic processes have been developed, notably the Houdry process, which have revolutionized the industry. Two companies alone have Houdry units in course of construction which, when operated in conjunction with their present refining units, will have a capacity of 300,000 barrels of crude per day, practically 10% of the total U. S. crude production. The operation of these units alone will decrease the production of Bunker C by 10% since, with this process, there is no Bunker C residue.

Other refineries and equipment manufacturers have alternate catalytic processes in development and some are even in production. From these developments only one thing is certain, that the supply of Bunker C will be *materially* decreased as these units go into operation. This fact, coupled with the rapidly improving statistical position of Bunker C (from the refiners' viewpoint) strongly indicates that the June price increase was merely the first of a number to follow.

With the Houdry process it is possible to convert 100 barrels of Bunker C into approximately 45 barrels of high-octane gasoline and 55 barrels of light furnace oil, more than doubling its market value at but slight expense. The refiners are hard-headed business men and to them a byproduct is a byproduct, something to be disposed of for what it will bring when stocks are excessive, but when demand exceeds normal supply someone has to pay for the tail wagging the dog —and it won't be the refiners.

How does this affect the operator or management of fuel-burning plants? By placing a much higher premium than in the recent past on the firing of coal as the primary fuel with oil as an auxiliary. Provision for the auxiliary firing of oil is highly desirable as a matter of insurance against possible interruption of coal supply from any cause whatever. With combination coal and oil firing, it is possible to operate safely with only small coal-storage facilities, eliminating the necessity for the reserve coal supply with its attendant costly rehandling, losses and idle investment.

Even in plants where installation of oil-storage tanks, pumps and heaters is out of the question, combination burners can be supplied with oil by temporary facilities that can be arranged for in short order should the necessity arise.

The situation indicates that more plants will provide for, or return to, coal firing because of probable increases in the price of Bunker C oil and that many more combination coal-oil burners will be installed.

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The Lost Residual

By N L REA, *General Electric Co*

ONCE UPON A TIME a "hurry" call came from a small knitting mill. Their generator would not generate. They were without lights and in a bad way.

A trouble-shooter reported late Friday afternoon and found a new breed of cat—at least one he had never heard of before or since—a "Loomis" generator. This consisted of a small armature surmounted by a pair of tremendous fields, the latter being compound wound. Located in the basement of the knitting mill, the generator was driven from a line shaft by a pair of fast-and-loose pulleys. The plant itself was driven by a Corliss engine. High water from a nearby river had backed up into the basement, flooding the armature and pole pieces. The field coils, however, had been above the high-water mark. The armature was taken out and placed in a drying oven over the week-end.

Monday afternoon another call advised that the generator was back together, but that there was no juice, and—"What to do now?"

The trouble-shooter sallied forth again, loaded for bear with tools and instruments. A careful check, going by dirt and paint marks on connectors and wires, plus many questions, showed that no connections had been changed. The voltmeters showed a faint indication of voltage, and the meter moved a shade higher when the shunt field was closed. It went a bit higher yet when the rheostat and external field wiring were short circuited, but the generator refused to "pick up."

All this went on by the light of an oil lantern held by the plant engineer, a tall, lanky son of Erin. The plant owner, a short roly-poly, and his skinny little assistant, were much under foot. They were paying for an expert on an hourly basis and wanted to know what they were getting for their money's worth, and also to find out what was done to avoid future expense.

A remark by the erector that the residual was too low was instantly picked up by the engineer.

"Begorra, I know phwat happened! The wather came in dom quick, but it was a long time in goin' out. So it stands to rason that the wather goin' down slow as it did soaked out all the dommed residual from them pole pieces!"

While this was given as a positive statement, he wanted the trouble-shooter's confirmation. So, for politeness sake, and to help Pat's standing with his boss as well as impress the audience, the trouble-shooter agreed that this sounded reasonable.

The generator wouldn't work

What to do about it was the question. No source of dc within miles and immediate action needed. Well, the generator was stopped, a piece of No. 18 copper wrapping wire from the shooter's kit placed across the main switch contacts, and the switch closed over the wire. Then the belt was slowly shifted to the live pulleys. As the belt began to squeal, the trouble-shooter volunteered, "I wouldn't look at that switch, if I were you!" Of course all three did, and then she b-l-e-e-e-w!

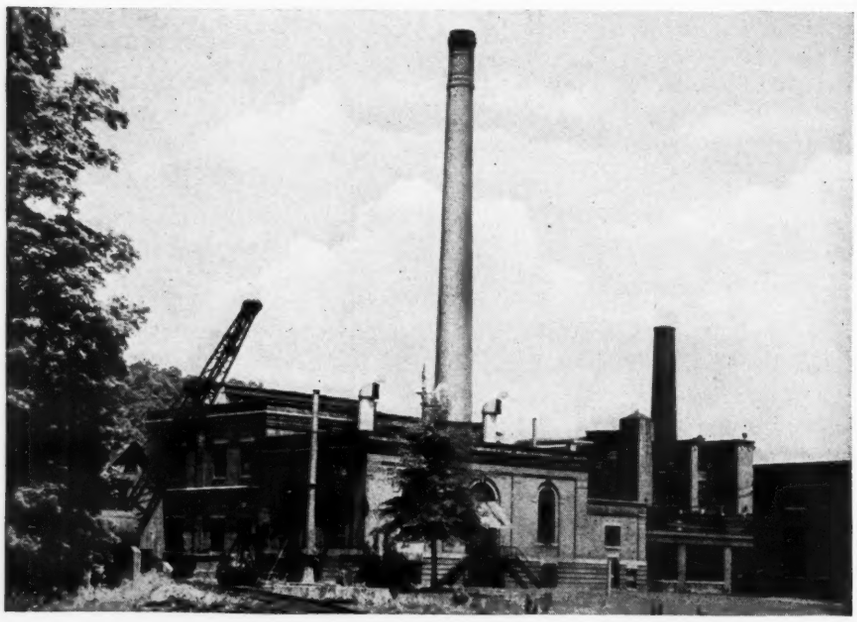
The three spectators piled up in the narrow doorway at the foot of the stairs, but they had plenty of light to get untangled as the short through the series field restored the "water-soaked" residual and all was O.K.

R Wallace Stretches Its Power Dollars

New turbines, unusual air preheater, additional stage of feedheating, revamped heating system and ingenious improvements in operation all add up to power savings at plant of famous silversmiths in Wallingford, Conn.

BACK IN 1835, spoons were made from Sterling silver or from pewter. Like all apprentices of the times, young Robert Wallace learned to make both kinds. But unlike his contemporaries, Robert Wallace had imagination and courage enough to break away from tradition. When he heard of a new composition, called German silver, he bought the only bar in the United States from a visiting scientist, had it sheet-rolled and made the first nickel-silver spoon seen in this country. On this daring start he built a successful business and his descendants, following his progressive methods, have seen it grow into the present famous plant at Wallingford, Conn.

In the power plant as well as the factory, from the waterwheels of 1835 to the steam plant of today, continuous modernization has been a habit. It only takes a short talk with John T Matson, power engineer, to learn how thoroughly this philosophy of regular improvement in equipment and operating methods is followed at the R Wallace plant. Efficiency and cost figures for years back show yearly improvement corresponding to changes, large or small, made during the year. Biggest drop in cost began about three years ago when major modernization was undertaken.



This power house supplies three companies with electricity, process and heating steam

The R Wallace power plant is really a small central station; it serves three companies grouped in a valley just outside the town of Wallingford—R Wallace Sons Mfg Co, The Wallingford Co, and the Wallingford Steel Co. All take electric power from the plant, the electric furnaces and rolling mill of the steel company representing a particularly heavy block of load. R Wallace and the Wallingford Co take steam at 150 lb for fire and service pumps and other auxiliaries. All take steam at 30 lb; about one-half of the total goes for heating, and about one-quarter for process at R Wallace and the Wallingford Co, and about one-quarter for process at the steel company.

Growth of electric load in relation to steam load pointed to the turbine room as the place where modernization would yield best returns. New equipment not only increased capacity but produced more kwhr from each pound of steam. However, the boiler room was not neglected, and minor changes there mean more pounds of steam from each pound of fuel. Finally, to complete the circle of savings possibilities, steam-using equipment was overhauled so that the same job can be done with fewer pounds of steam.

Boiler Room

The boiler room had its turn in the continuous modernization program back around 1920-22. During those years, four 5000-sq-ft B & W stoker-fired Stirling boilers were installed. Around 1930, shifting prices made it profitable to convert these units to oil firing. The first three were fitted with Bethlehem burners and the last with a B & W burner (all mechanical atomizing). Installation of four 25,000-gal. heated storage tanks in old coal bunkers and two fuel-oil pumps and heaters piped for interchangeable operation completed the conversion to oil. In addition to fuel savings, the changeover increased boiler capacity and operating flexibility.

Installation of B & W superheaters

in 1935 was a necessary preliminary to turbine-room changes then being planned. This equipment permitted raising total steam temperature to 550 F; pressure was held at 205 lb.

Final improvement in the boiler house came about last winter with the construction of an unusual air preheater. As shown in the picture, this consists of nothing more than a duct for picking up heated air over the boilers and bringing it down to the forced-draft fans to be supplied to the boiler furnaces through a common duct. This does two jobs; it supplies burners with air at 110 F or better, producing savings estimated at $1000 a year, and it keeps the boiler room cool, since the fan draws heated air rather than taking in relatively cool air at the floor level.

There are two forced-draft fans; one is powered by a Terry steam turbine and the other by a Sturtevant engine, as is the single induced-draft fan. Under normal conditions, the 175-ft brick stack provides enough draft, but the induced-draft fan comes in handy on heavy load swings.

Regulators

A Mason hydraulic-operated regulator controls oil pressure in relation to steam pressure by moving weights on the beam of a Leslie reducing valve in the steam line to the oil pump. The regulator also governs air supply by operating a Ruggles-Klingemann chronometer valve in the steam line to the fan drive. Feedwater regulators (Copes) on all boilers insure better control of water level and give firemen spare time that can be put to use at other jobs.

The present turbine room houses four units with a total capacity of 5000 kw. The oldest units, now held for standby, are a Terry turbine, originally designed to bleed at 30 lb, driving an Allis-Chalmers 500-kw generator, and a 1000-kw General Electric unit (1922) which was also designed to bleed (at 2 lb). Bleed lines of both have been disconnected. One of these units operates about 45 hours per week during peak-load periods, while the other is in reserve. Both are served by surface condensers.

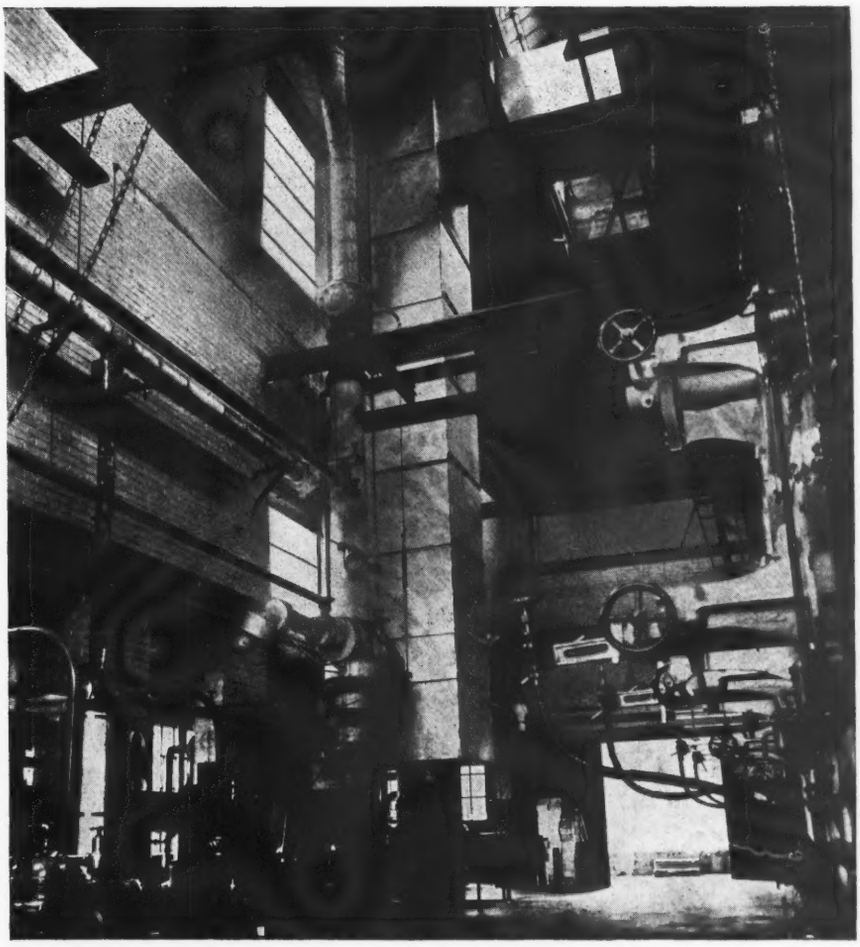
The two remaining units represent the last step in turbine-room modernization; the smaller, a 1500-kw machine, was installed in 1936 and the larger, a 2000-kw unit, was added in 1938. Both are Westinghouse extraction-condensing machines with hydraulic governing, driving 0.8-pf, 600-volt, 3-phase, 60-cycle, 3600-rpm generators. Both take steam at 190 lb and 100-F superheat, bleeding at 30 lb. Auxiliary equipment (all Westinghouse) includes:

	1500-kw unit	2000-kw unit
Generator air cooler	605 sq ft	750 sq ft
Condenser (radial, 2-pass)	1750 sq ft	2500 sq ft
Circulating pump	2625 gpm 575 rpm	3100 gpm 575 rpm
Pump motor	20 hp	25 hp
Condensate pumps (2)	65.4 gpm 1750 rpm	85 gpm 1750 rpm
Pump motors	5 hp	7.5 hp

Air-removal equipment — Two compound Le Blanc steam-jet air pumps mounted on a common surface inter- and after-condenser

Each of the new units has a direct-connected exciter of sufficient capacity to serve all generators which might be operated at any one time, and a Terry-turbine- and synchronous-motor-driven duplex exciter is in reserve.

Condensing water comes from the Quinnipiac River, a small stream formerly used for water power. The two old wheels are now shut down but water just above the spillway gate still flows to the condenser well. Because the stream is narrow and tree-shaded, leaves and debris create a real problem and the steps taken to prevent them getting into condenser circuits illustrate the small things that go to make up a program of continuous modernization.

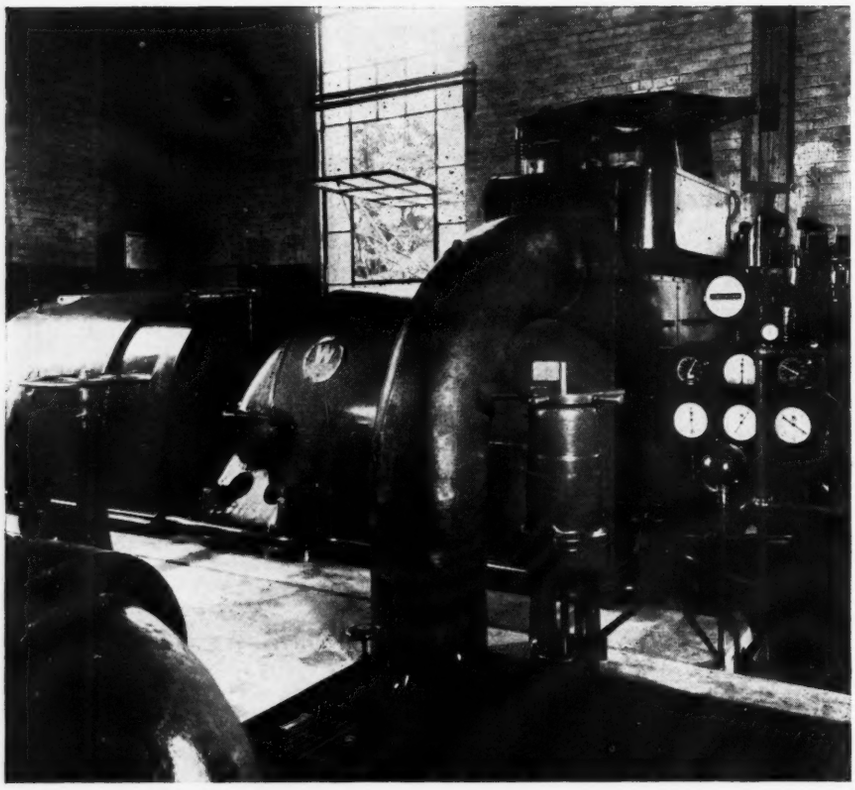


Unusual preheater consists of duct for drawing combustion air from heated space over boilers—raises efficiency and keeps boiler room cool

First, a wooden boom buoyed by gallon jugs was run down stream to the spillway to keep out leaves and floating debris. The spillway gate raises and lowers to regulate flow and making the water flow over the top gives some further cleaning. Three screens in the condenser well means that one can be removed for cleaning at any time without dirt passing. A float, chain and pulley arrangement shows water level in the turbine room. These changes and constant watchfulness have reduced need for condenser cleaning and have insured continuous operation. Regular cleaning is at about 6-week intervals; every 12 weeks tubes are air-blown; about twice a year tubes get a good scraping.

Boiler-Feed System

Revamping of the feed-heating system was carried out in the spring of this year. In summer about one-half of boiler feed is makeup (from the Quinnipiac River), while in the winter this drops to about one-third due to returns from the heating system. Regular analysis determines amount of treatment needed, which follows the Dear-



New 2000-kw condensing-extraction unit bears brunt of growing load

born system used the past few years.

Formerly all feed-heating was done in one stage, using a 375-sq-ft spiral-coil heater, taking 3-lb steam from exhaust of engines, steam pumps, and air compressor. To utilize heat more effectively, and to supply hotter water to boilers, another stage of heating was added, which raises water to 265–272 F. The old heater was replaced with a new 8-pass, 520-sq-ft, straight-tube unit, easier to clean. The 30-lb heater is also straight-tube.

Feeling that savings in steam use are worth as much as gains in efficiency of generation, a major part of the modernization program was complete overhaul of the heating system. The R Wallace plant, alone, comprises 45 buildings spread over 22 acres. These are served by a vacuum heating system fed with 30-lb steam (through a reducing valve) and with surplus exhaust from auxiliaries (through a spill-over valve). First step consisted of an exhaustive check for leaks. When maximum tightness was achieved, the system was checked for places where heating was inadequate. These were mostly at points remote from the power plant.

Ingenious boosters solved the problem of hard-to-heat spots. Connections were made from nearby 30-lb process lines to ells near the bad spots. Steam flow from 30-lb lines to heating lines was put under control of solenoid valves. Admitting high-pressure steam increased heat units going to a given spot and also, by an aspirating effect, improved flow of low-pressure steam. Boosters are cut in and out of operation from the turbine room where the controls for the solenoid valves are centralized. A Tagliabue 12-point strip-chart recorder shows temperatures in strategic parts of the plant and guides operators in use of boosters.

To operate old and new equipment with maximum effectiveness requires a close knowledge of all phases of plant construction, so part of funds for modernization was spent wisely on instruments. These included: three Cochrane flowmeters for steam bled from 1500-kw and 2000-kw units and steam sold to steel mill; Bristol recorders for boiler pressure, oil pressure, forced- and induced-draft, 30-lb header pressure, temperature of oil from tank, outside temperature, preheated-air temperature; a Bristol combination vacuum and pressure gage for the heating system; four Consolidated-Ashcroft-Hancock recorders for steam temperature; a General Electric voltage recorder; and a Ranarex CO_2 recorder to add to the existing unit. These new items, plus existing meters, give the plant an unusually complete set-up, and one that is really used.

New equipment and major changes are only part of the story at R Wallace. Chief Matson and his men display all the ingenuity of true Connecticut Yankees in rigging up kinks and devices to make operation easier, safer, and more reliable. There are so many of these "practical aids," and the way they have been worked out is so interesting, that they rate a separate article. See next month's *Operating Engineer* for story and pictures.

GAINS FROM MODERNIZATION

R Wallace & Sons Mfg Co, Wallingford, Conn.

Year	*Total kwhr*	*Gal. of oil burned*	*Kwhr per gal. of oil*
1933	4,691,380	2,239,155	2.09
1934	5,131,740	2,274,005	2.25
1935	5,579,190	2,295,376	2.39
1936	7,021,700	2,319,064	3.09
1937	8,653,500	2,378,473	3.63
1938	7,101,800	2,060,747	3.45
1939 (1st 6 mo.)	4,541,400	1,202,617	3.78

Last weekly record available shows 4.96 kwhr per gal.

Year	*Heating steam, lb*	*Average Temperature* for same period*
1935	48,736,800	36.5
1936	38,508,900	36.3
1937	30,687,000	38.7
1938	23,907,000	38.9

* Taken from data compiled by U. S. Weather Bureau at New Haven, Conn.

Note: In a power-process-heating plant, it is difficult to find a single index of gains made by modernization. The above figures show how steam required for heating was cut in four heating seasons of approximately equal intensity. Although the data on kwhr and gal. of oil make no allowance for heating or process steam, the general conclusion can be drawn that a greatly increased electrical load and a more or less constant heating *load* were supplied with greatly reduced unit fuel consumption.

Dual-Fuel-Fired Boilers Automatically Controlled

Combustion control on two high-pressure boilers, burning varying quantities of blast-furnace gas separately or in combination with pulverized coal, automatically adjusts fuel and air supply to maintain continuous practical-test conditions

By A L STEWART
Vice President and Manager
Bailey Meter Co, Ltd

IN THE NEW high-pressure steam plant of Dominion Steel & Coal Co, Ltd, Sydney, N. S., two boilers are fired with blast-furnace gas and pulverized coal. These boilers are rated 186,000 lb of steam per hr at 475 lb and 750 F when burning pulverized coal and 165,000 lb when burning raw blast-furnace gas. Each boiler has 3 gas burners, each rated to burn 900,000 cu ft of gas per hr, and 2 pulverized-coal burners, each rated 14,000 lb of coal per hr and supplied by its own pulverizer. For a complete description of this plant, see POWER, November, 1938.

Raw blast-furnace gas taken directly from furnaces is the major fuel. Normally, all gas available is burned and pulverized coal is varied to hold constant steam pressure. Burning these fuels in varying combinations or separately presents several interesting automatic-combustion-control problems. In addition to the automatic-combustion control, the boilers are completely metered and operated continuously under practical-test conditions.

Metering Equipment

Fig. 1 shows the master panel and the two boiler panels, one on each side of the master. These panels, on the operating floor, face space between boiler fronts, a location from which the operator can see the burners and the pulverizers. The master panel includes the master steam-pressure recorder-controller which records steam-header pressure and pressure in the gas main at the boiler plant. There are also the 150 lb auxiliary steam-header gage, a telechron clock, master selector valve, dial thermometers indicating coal-and-air mixture temperature in each pulverizer, an indicating air-pressure gage, and signal lights for low gas, steam and air pressure and high-low boiler water.

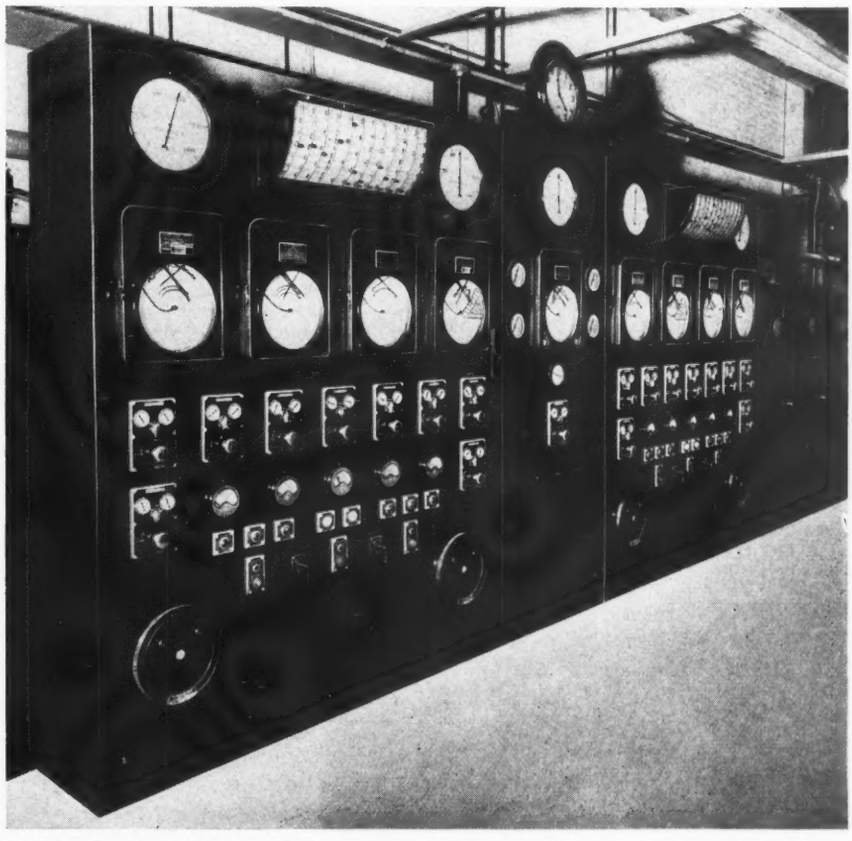


Fig. 1—On the master panel (center) and boiler panels at each end are centered all metering, automatic and manual control equipment for the two boilers

On each boiler panel is mounted a 12-unit draft gage; pressure gages for indicating boiler-drum pressure, and feedwater pressure at the feedwater-control valve; a 4-pen temperature recorder; a boiler meter indicating, recording and integrating steam flow, and

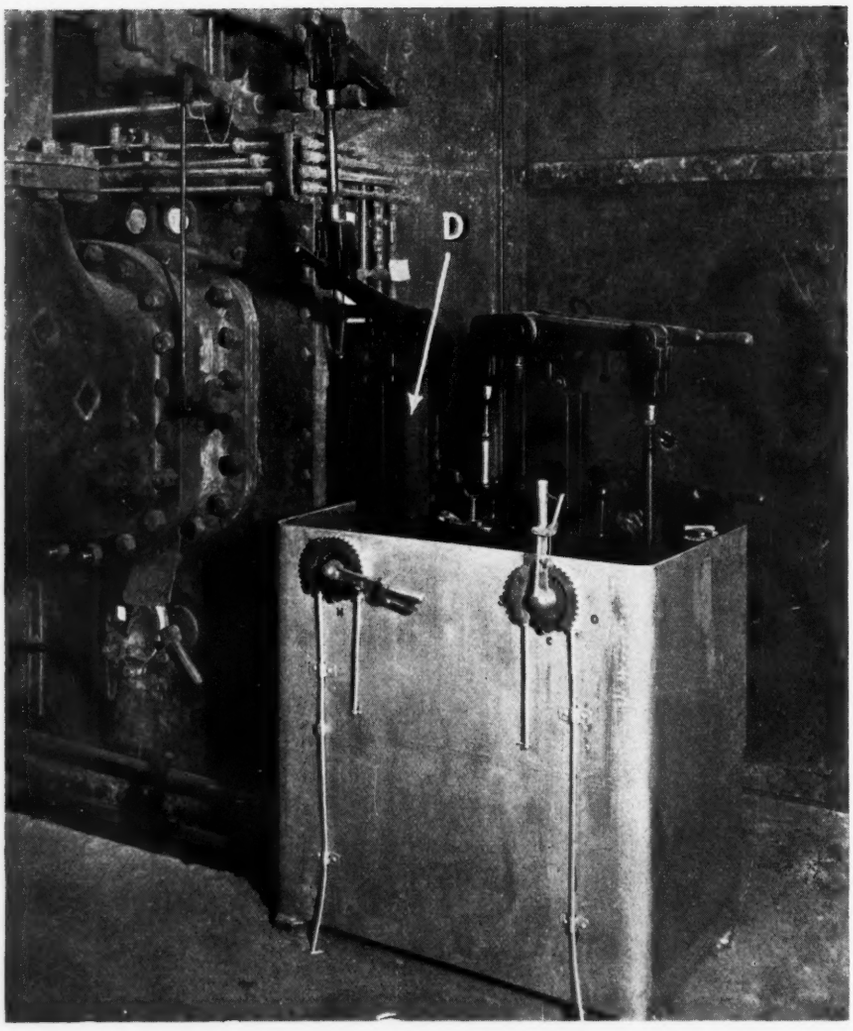


Fig. 2—This group of drives positions the blast-furnace gas dampers and the pulverized-coal primary-air and secondary-air dampers. Levers on the controls prevent manual operation if the air supply for automatic operation fails

compensator operates on differential pressure across an orifice plate in the gas-line supplying the burners. This differential is an accurate measure of gas flow, since the orifice is of the segmental type and is installed at the top of the horizontal gas duct. In this position, dust and foreign matter cannot collect on the orifice plate, which might occur on the inlet side of a standard concentric-type orifice plate commonly used in pipelines.

Automatic Control

Control of this installation, while rather special, is almost entirely automatic. It is centered in the panels, Fig. 1, and all major operations are controlled from this position. A master steam-pressure controller (Bourdon-tube type) connects to the main steam header. Pressure at this point, which varies with increase or decrease in steam demand, primarily actuates the control system. The Bourdon-tube free end connects to a pilot valve. Movement of this valve varies the air-loading pressure transmitted through a master selector valve on the master panel, to the control drives positioning the primary air dampers in connection with the pulverizers. Since pulverized coal supplied to the burners responds automatically to changes in primary-air flow through the pulverizers, each pulverizer has a controller to start and stop automatically the feeder motor to maintain raw coal in the mill proportional to primary-air flow.

These pulverizer controllers, mounted

recording air flow; a meter recording and integrating feedwater flow to boiler, recording water temperature entering economizer, water temperature leaving economizer and steam temperature at superheater outlet. Each boiler panel also mounts the various selector valves for the automatic combustion-control system, indicating ammeters, start-stop stations and signal lights for the motors, and the pulverizer controllers. Coal to each pulverizer is measured by a coal meter in the pipe running from the overhead bunker to the pulverizer.

Flow-Effect Compensators

A feature of the boiler meters is that they are equipped with automatic flow-effect compensators. Despite the great difference in flow of pulverized coal and blast-furnace gas, this device compensates the air-flow reading so that regardless of proportions of the two fuels being burned, steam-flow and air-flow records will coincide when most efficient conditions prevail. The flow-effect

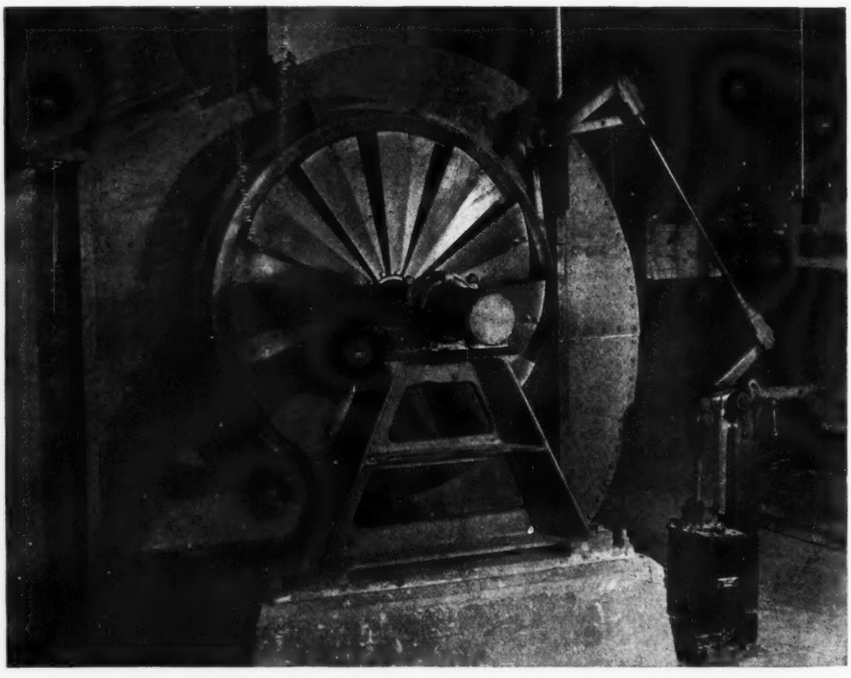


Fig. 3—Control vanes on forced-draft fans are automatically positioned to maintain constant forced-draft-duct pressure by a control drive alongside the fan

near the bottom of each boiler panel, each have two diaphragms, large and small. Differential pressure across the mill actuates the small diaphragm and that, across a primary-air pipe orifice, actuates the large diaphragm. When coal level in the mill decreases, the mill differential decreases until finally the ratio between primary-air differential and mill differential is such that an electrical contact is made to start the raw-coal feeder motor. When coal level has increased to where the ratio between primary-air differential and mill differential is normal, the contact is broken and the feeder motor stops.

The blast-furnace-gas supply is extremely variable, and since we want to use as much of it as possible, butterfly valves admitting gas to the burners are normally left open. They may, however, be manually positioned by air pressure through selector valves mounted on the boiler panels. When there is sufficient gas to operate either one or both boilers on gas alone, the selector valves may be positioned automatically from the master steam-pressure controller.

Gas Dampers

The three gas dampers for three gas burners on each boiler are connected by linkage to a common shaft. This shaft is rotated by control drive *D* in the group of three, Fig. 2. The other two drives operate the secondary-air and primary-air-dampers for No. 1 pulverizer. The control drives have levers for manual operation, should air pressure fail. A similar group of drives for No. 2 pulverizer and for positioning the secondary-air dampers are on the opposite front corner of the boiler.

To supply the proper amount of air for each fuel, regardless of proportions of the two being burned, ratio controllers proportion the secondary air to both pulverized-coal and gas burners. In one of these controllers, gas flow is balanced against air pressure in the gas-burner box. A resulting air-loading pressure operates a control drive that positions the secondary-air dampers at the three gas burners. In each of two other controllers, primary-air flow to the pulverizer is balanced against air pressure in the pulverized-coal-burner box. A resulting air-loading pressure operates a control drive that positions the secondary-air damper at the pulverized-coal burner supplied by that particular pulverizer.

Forced-draft-fan inlet vanes are positioned automatically by a controller, Fig. 3, to maintain constant forced-draft-duct pressure. Induced-draft fans are driven by steam turbines, speeds of which are controlled automatically by throttle-valve adjustment to maintain constant boiler-furnace draft, by a controller actuated by furnace pressure. Because of the number of variable factors, including gas supply, gas pressure, and heat content of gas, provisions were made for remote manual control by air pressure through selector valves on the boiler panels of each element in the combustion system and feedwater flow.

Start-stop stations for the mill motors, primary-air-fan motors and forced-draft-fan motor, as well as transfer switches for pulverized-coal-feeder motors are conveniently grouped on the boiler panels together with indicating ammeters on the motors, and signal lights indicating which motors are operating. Centralized control of the motors has been very convenient in this plant, where the pulverizers must be started and stopped frequently, as dictated by gas supply and steam demand. This is done manually. In the interest of safety, no attempt was made to design the control to automatically start or stop the pulverizers.

On the master panel are mounted the signal lights which indicate low steam pressure, low gas pressure and low air pressure; also high and low water level in the boiler. If a condition develops to give an alarm, the horn and signal lights are energized simultaneously. After approximately 5 sec, a relay cuts out the horn but the light stays on until the fault is corrected. In this way, the horn attracts the operator's attention, and the signal light indicates where the fault is. Stopping the horn after a predetermined interval eliminates unnecessary noise and leaves the horn available to give an alarm should another fault develop before the first is corrected. This arrangement eliminates need for separate individual alarms of distinguishing pitch.

Safety Interlocks

The safety interlock equipment consists of two diaphragm-operated draft units equipped with adjustable magnetic mercoids for making electrical contact. One of these units is connected to the induced-draft-fan inlet, and the other to the forced-draft-fan discharge. If either fan stops, a mercoid makes contact and shuts down the other fan, pulverizers, primary-air fans and coal feeders, and closes the gas valves. The gas valves will also close if the electric power supply fails.

To guard against a dangerous condition developing when starting up the boilers, either from cold or following a temporary shutdown, motors are interlocked so that the induced-draft fan must reach a certain speed before the forced-draft fan can be started. When this fan has been started from a push button on the boiler panel, either pulverizer can then be started by a single push button which starts the primary-air fan, pulverizer and feeder motors in automatic sequence.

Feedwater Control

Feedwater control is of vital importance in an installation of this kind. An air-operated control, Fig. 4, consists of a diaphragm-operated control valve in the feedwater line to each boiler, positioned by air-loading pressure transmitted to it from an air-pilot valve in the boiler-water-level recorder. Feedwater input is therefore controlled in accordance with drum level. A selector valve mounted on the panel permits

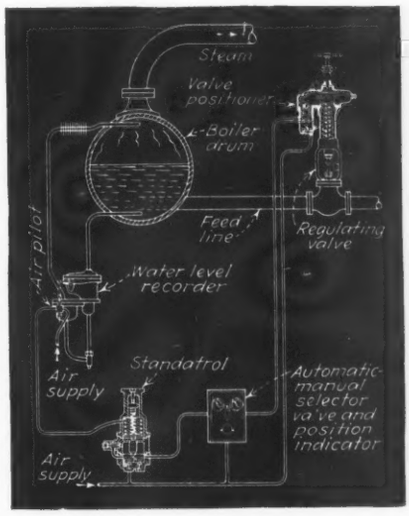
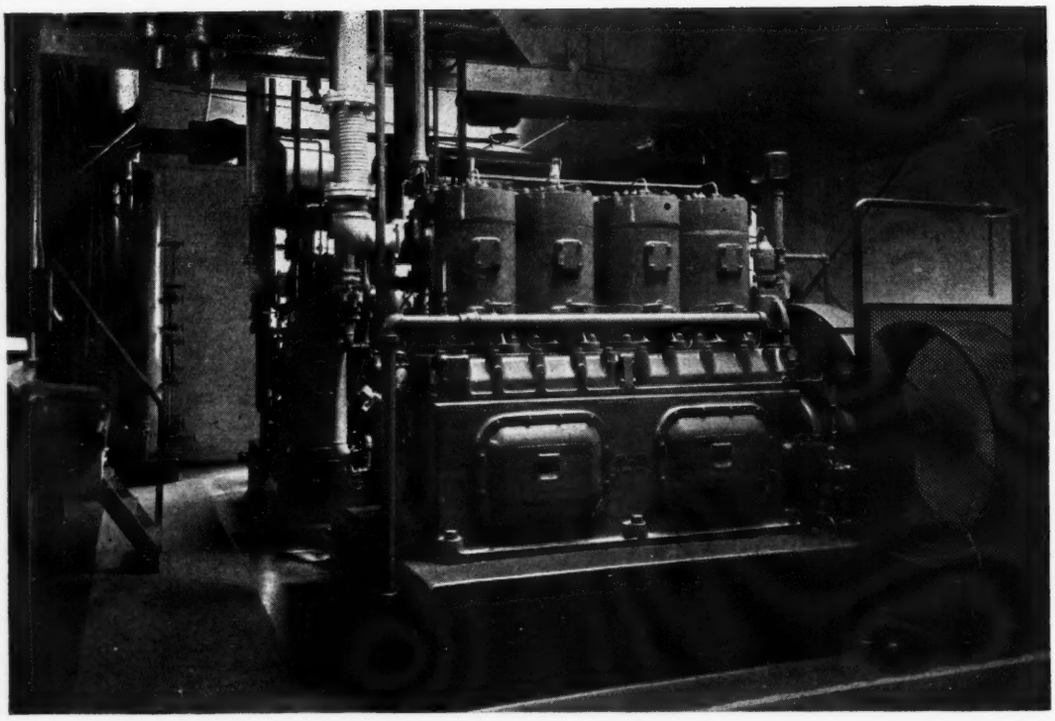


Fig. 4—Diagram of air-operated feedwater control

remote manual control when desired. A pump governor in the turbine-driven boiler-feed-pump steam line, and an excess-pressure valve in the motor-driven boiler-feed-pump discharge line, maintain a constant excess feedwater pressure over steam pressure at all times. This is essential for most satisfactory feedwater control.

The first of these boilers was started in October, 1937, and the second a month later. The metering and control equipment, supplied by the Bailey Meter Co, Ltd, Montreal, Quebec, went into service with the boilers. It was finally adjusted for optimum conditions, based on observations and exhaustive combustion tests conducted during subsequent months. The operation of the entire plant has been very satisfactory, and the metering and control equipment has made it possible to maintain practical test conditions under everyday plant operation.



Of the two 150-hp natural-gas units, No. 1 (foreground) generates both electricity and refrigeration. No. 2 produces refrigeration only

Double-Duty Gas Engines at Knudsen Creamery

Two 150-hp units in West-Coast plant, one generating electricity and the other carrying major refrigerating load, lower power costs. Lube-oil consumption runs less than 1¼ gal. per day per engine, says Chief Sherwin

AMONG the many modern gas-engine power plants of Los Angeles and vicinity is that of the Knudsen Creamery Co. Its two 150-hp engines are operated on the high-quality (about 1100 Btu per cubic foot) natural gas of this region. They supply, through direct power, all of the refrigeration used in the creamery and generate electricity to drive the refrigerating auxiliaries and light the establishment. Electricity required for other purposes is purchased. Before the engines were installed (July, 1938) all refrigeration was supplied by motor-driven ammonia compressors and all energy was purchased.

While the two engines are basically identical, they serve distinct purposes. One, generating electricity and supplying some refrigeration, must operate at constant speed because of the connected generator. The other, carrying the major refrigerating load and generating no electricity, can run fast or slow, according to the refrigerating demand, thus insuring maximum efficiency of operation.

Both engines are Worthington "LCE-4", 4-cyl, 150-hp, 350-rpm, 11½-in. bore and 12-in. stroke. They have a compression ratio of about 9.5 to 1.

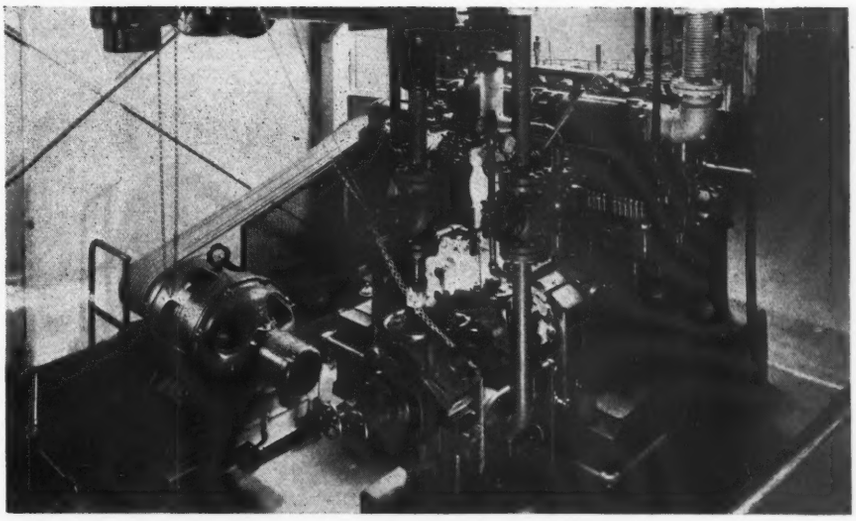
Engine No. 1, supplying refrigeration and generating electricity, is multiple V-belted to a Westinghouse generator, 75-kva, (60 kw at 80% power factor) 3-phase, 60-cycle, 240-volt, with a 2-kw direct-connected exciter. This generator runs at a constant speed of 1200 rpm.

Its single, horizontal ammonia cylin-

der is powered directly from the engine crankshaft through the compressor connecting rod. A similar cylinder can be added later at the generator end if load growth requires it. The compressor cylinder is Worthington-Carbondale, 7¾ x 12 in., double-acting. It rates 44 tons (at 25 lb suction and 175 lb head pressure).

Engine No. 2 has no generator, but two compressor cylinders identical with that just described.

The three compressor cylinders are so connected that it is possible to work simultaneously at three different suction pressures: 15, 25 and 40 lbs.



No. 1 engine is multiple-V-belted to 60-kw ac generator. Ammonia-compressor cylinder in foreground is rated at 44 tons

Starting and Control

The engines start manually by compressed air. Unit No. 1, because of its generator load, is under constant-speed governor control. The speed of unit No. 2 is controlled automatically with a Mason-Neilan regulator to maintain the desired temperature. Control is two speed—high and low, permitting the engine to operate at good m.e.p. and high efficiency.

Both engines will stop automatically if the jacket water overheats, if ammonia head pressure gets too high and if the engine oil pressure drops too low.

One of the 7¾ x 12-in. ammonia cylinders on Unit No. 2 has been replaced with a 9 x 12-in. cylinder for the specific purpose of precooling 21 delivery trucks each day. Each truck is fitted with two holdover plates. The temperature of the trucks when returning to the plant in the evening is about 40 F.

The engine-exhaust system includes a shell-and-tube heat exchanger for making service hot water and a Maxim silencer. Gas-fired boilers supply the plant with process steam.

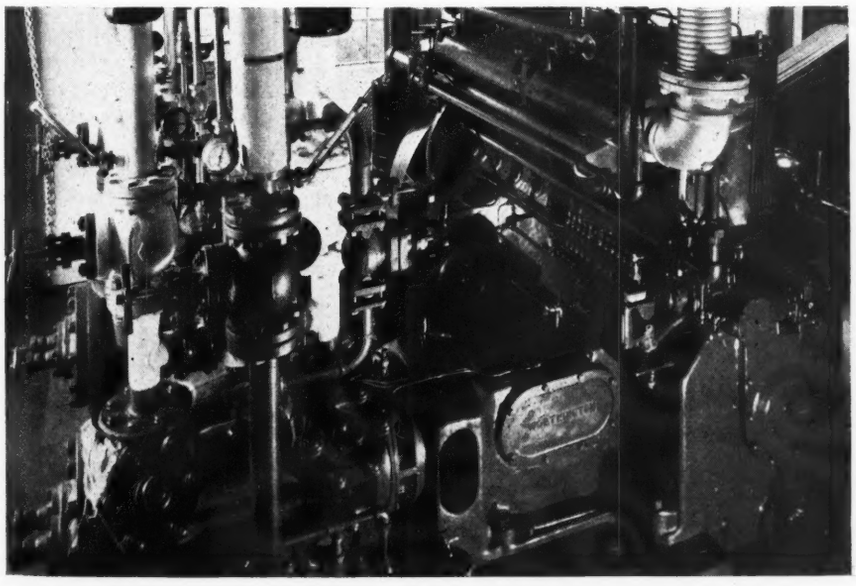
The engines are cooled by a closed-circuit system with heat exchangers and evaporative condensers. Full load consumption of gas is about 9.5 cu ft per hphr, making the gas cost about 3 mills per kwhr.

The Carrier evaporative condenser is rated 150 tons at 70-deg wet-bulb air temperature, 155-lb head pressure, with 240 gpm of water pumped over the condenser. The air supply is served by two 30,000-cfm, 7½-hp Buffalo fans. The evaporation rate is about 4000 gallons of water per day. The condenser is built in two sections, arranged so either can operate independent of the other.

The Vetter-designed ammonia superheat remover and oil trap has a capacity of about 15 tons and removes 100 degrees of superheat. The Vetter brine tank has four batteries of coils, two on each side. The coils consist of 6900 lineal feet of 1¼-in. pipe. The brine tank is 50 ft by 16 ft by 6 ft, and holds 35,000 gal. It is divided into two independent sections by lengthwise partitions.

The York Flakice machine, rated 10 tons per day, is said to be one of the first of this type installed on the Pacific Coast. The refrigerating medium is calcium-chloride brine, ammonia-cooled through a York shell-and-tube brine cooler. Two storage bins in the plant hold 10 tons of ice each.

No. 2 unit, showing two horizontal 44-ton ammonia-compressor cylinders working directly off engine crankshaft



Power Costs

Chief engineer Tom Sherwin says that lube-oil consumption is less than 1¼ gal. per day per engine. He also claims that this installation is saving money over purchased power. Power purchases, before the plant went into operation in July, 1938, ran from 4500 to 5000 kwhrs per day at an average cost of approximately $40.00 per day. At the present time, an average of 1400 kwhrs is purchased per day at an average cost of about $14.00, and the plant generator supplies about 1450 kwhrs per day.

It will be noted that these add up to 2850. The difference between 2850 and the 4500 to 5000 kwhrs formerly purchased reflects the replacement of motor-driven refrigerating compressors by the refrigerating cylinders being incorporated in the engine units. It should be noted in this connection that whereas refrigerating capacity of the plant prior to installation of engines was 67 tons, it is now 132 tons per day.

The actual gas consumption of the engine plant runs from about 40,000 cu ft per day in winter to 50,000 cu ft in summer.

Down Where the Electrons Flow

Electrons and electronic devices are in the limelight—here's what you need to know to determine if they will help you run your plant better and where they can be best applied

By C T PEARCE
District Engineering Manager
Westinghouse Electric & Mfg Co

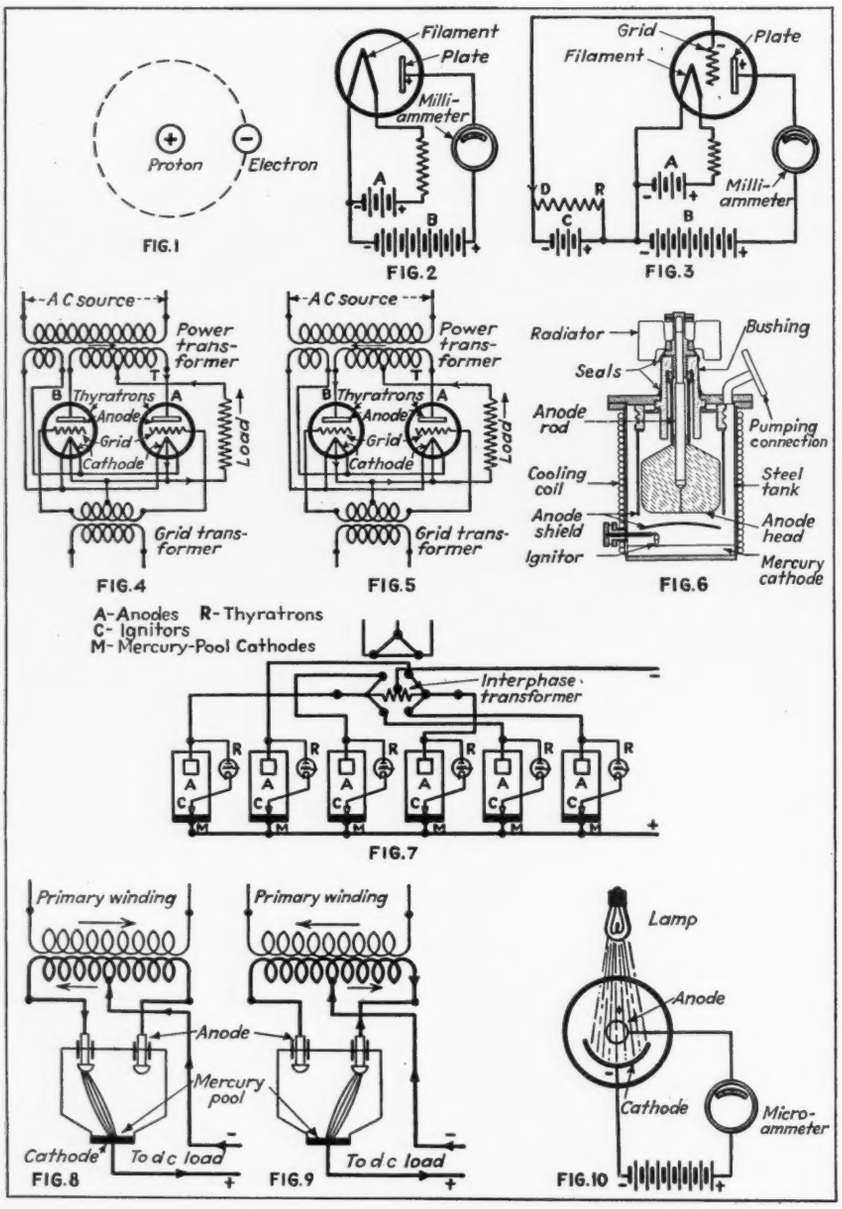


Fig. 1—Diagram of a hydrogen atom. Fig. 2—Circuit diagram of a 2-element electronic tube. Fig. 3—Circuit diagram of a 3-element tube. Figs. 4 and 5—Two Thyratrons connected to rectify alternating current. Fig. 6—Simplified section through Ignitron rectifier. Fig. 7—Circuit diagram of an Ignitron rectifier. Figs. 8 and 9—Circuit diagrams of a mercury-arc rectifier. Fig. 10—Circuit diagram of a photoelectric tube

ELECTRONIC DEVICES, in the form of the vacuum tube, were developed in the radio industry. Their use in this field revealed certain fundamental advantages, which have been carried over into other applications. In some instances, entirely new uses, hitherto not considered because no equipment was available to give the desired results, have sprung up. In other cases, electronic devices have replaced rotating equipment or contactors because they do a better job.

However, they are not a cure-all nor universal devices that will supersede all others. Every case must be analyzed on its own merits, with proper consideration to initial cost, advantages or disadvantages in performance, and maintenance or upkeep. In this way, electronic devices will take their rightful place in the family circle of electrical equipment, along with motors, generators, contactors, etc.

What Electrons Are

Our present conception of matter is that each element is made up of infinitesimally small bodies known as atoms. Atoms, in turn, are composed of still smaller particles, some having a negative electrical charge, others a positive charge. The negative particles are called electrons and are assumed to rotate about a positive charge (the proton) in various orbits.

Beyond that, the hypothesis becomes somewhat complicated in conformance with the ideas of modern physicists. The hydrogen atom is the simplest in structure of the elements, and is considered as having one proton with one electron rotating about it, Fig. 1. The uranium atom, said to be the most complex, has 92 electrons moving in both circular and elliptical orbits, and in several planes, about a positively charged nucleus (proton).

An electric current is a flow of electrons, and to cause this flow, an electric potential is required. The electrons, being negative, are attracted to the positive terminal. Thus, direction of electron flow is from negative to positive, that is, opposite to the conventional assumption of electric current. In good conductors, such as copper, these electrons flow more freely than in other materials, resulting in a low electrical resistance. Conversely, electron flow in insulating materials is difficult to obtain.

In an evacuated chamber, electrons flow rather freely across space if subjected to a voltage, and the flow is greatly increased if the electron-emitting material is heated. This theory can be used to explain the results obtained in at least the majority of electronic tubes, and also permits a prediction of performance.

Electron Tubes

Electron tubes are made in many forms, simplest of which is the 2-element type, Fig. 2, which consists of a plate and filament. The filament, or cathode, is the part that makes the tube operative. It is heated by battery *A* to a temperature where negative electrons are given off into space. The plate, or anode, is connected to the positive side of battery *B* and is therefore positively charged and attracts the negative electrons given off by the filament. In this way, a current from battery *B* is conducted through the tubes and may be considered as flowing from the + side of the battery, through the milliammeter to the plate, across the space between the plate and filament, and to the — side of the battery.

In a high-vacuum tube with heated cathode, current flow is a function of cathode temperature and voltage impressed between anode and cathode. If a tube is filled with a gas or vapor of proper characteristics, an enormous increase in current can be obtained, with a greatly reduced voltage drop. Without going into detail, this results from the action of the positive gas ions which are formed. Mercury is one of the most commonly used materials for this purpose.

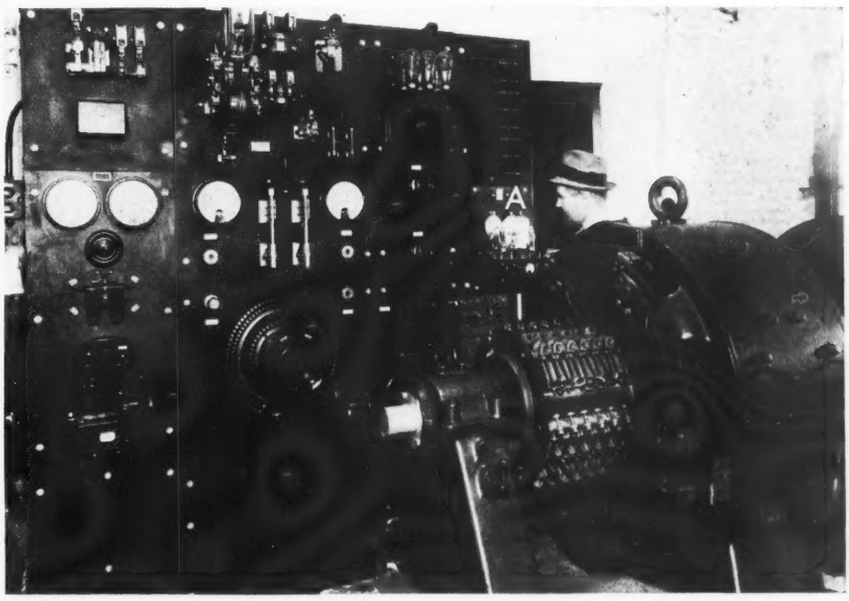
By equipping the tube with a third element, known as a grid, in the space between the cathode and anode, Fig. 3, an extremely effective means of control is obtained. If the grid is given a minus potential, it will oppose the flow of negative electrons from the filament to the plate and reduce flow of current through the tube. A minus potential on the grid of a few volts is sufficient to reduce the plate current to zero. Then, when the grid's negative potential is reduced, current flow through the tube will increase.

For example, in Fig. 3, by connecting the grid to the minus side of battery *C*, full voltage of the battery is applied between filament and grid. In other words, the grid is at a minus potential equal to the voltage of battery *C*. Assume this to be just sufficient to reduce the plate current to zero. Then, by moving contact *D* across resistor *R*, minus potential on the grid will be reduced and the plate current increased.

In a high-vacuum tube, as distinguished from the gas or vapor-filled type, a very slight change in grid voltage, other things remaining the same, gives a relatively great change in current flowing between the cathode and anode. The more positive the grid, with respect to the cathode, the greater the current flow. This effect is continuous and more or less proportional over a wide range in grid voltage.

In gas-filled tubes, used largely on alternating current, the operation of the grid is somewhat different. In this case, no current at all flows in the main circuit if the ratio of grid-cathode voltage is held below a certain critical value. Above this value, the tube breaks down and the grid has no further control over the current flow until the voltage of the ac circuit again goes through zero. Also, the tube can be made to conduct for any desired number of cycles before interrupting the current, thus forming a very fast and effective switch with no moving parts or arcing. A grid-controlled gas-filled tube is known as a Thyratron.

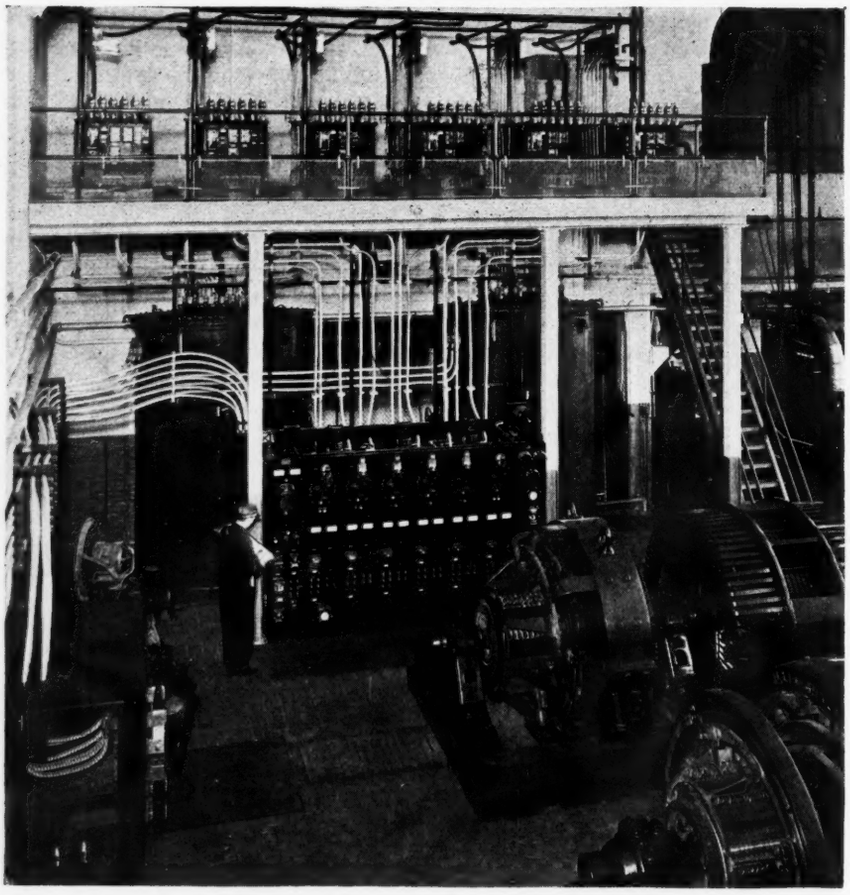
In many applications, Thyratrons are operated entirely from alternating current and the rectified output controlled by varying the phase of the grid voltage with respect to the anode voltage. Figs. 4 and 5 are simplified diagrams of how two Thyratrons may be connected to rectify alternating current. Current can flow only one way through the tubes which we will assume to be from plate to filament. Fig. 4 shows current flow for one alternation, which is from terminal *T* of the transformer through tube *A*, the load, and to the mid-point of the transformer. In Fig. 5, current is reversed in the transformer and current flow takes place through tube *B*. Current flow, however, is the same direction in both figures through the load. For simplicity, the grid-control circuit has not been shown. By properly connecting the grid circuit and controlling its potential, voltage of the rectified current can be regulated.



Parallel tubes in electronic speed regulator at A *govern paper-mill speed and prevent interruptions in production*

Still another means of control is employed in a device known as the Ignitron. This consists of an evacuated tube or tank containing a mercury pool. Into this pool dips an ignitor rod of resistive material; opposite it, and in as close proximity as possible, is the other main electrode or anode.

A simplified cross section and circuit diagram for the Ignitron is shown in Figs. 6 and 7. A Thyratron rectifier *R* permits current to flow through the ignitor crystal *C* to the mercury cathode at the start of the conducting period in the positive half of each cycle only. The passage of this current through the high resistance contact of the crys-



Six Ignitron rectifiers on balcony above transformers supply 4800 amp dc for hydrogen production in the Buffalo Electro-Chemical plant

tal with the mercury produces a cathode spot on the surface of the pool.

The arc then picks up and power current passes from the anode *A* to the cathode *C* during the positive portion of the cycle, after which the arc dies, the cathode spot disappears and is not re-ignited until the next positive half cycle. In turn, each of the units of the complete rectifier is ignited and take up the load, producing a smooth flow of power—much in the manner of a multi-cylinder automobile engine.

In the Ignitron, the spacing between anode and cathode may be close and the shields and grids may be reduced to a minimum, thus reducing the arc drop to a point approaching the theoretical minimum.

The mercury-arc rectifier is also an electronic device, although it is built in large sizes and competes with motor-generator sets and rotary units for converting ac into dc. The cathode is a mercury pool, and there are usually six or more anodes grouped in one metal tank. Each anode corresponds to a phase, and the arc is transferred from one anode to another as each anode becomes more positive, with respect to the cathode, than the preceding anode. By making use of several phases, obtained through a transformer, the wave form of the dc output is very much improved.

Mercury-arc rectifiers may or may not be equipped with grids to give control of dc output voltage. Figs. 8 and 9 show two simplified diagrams of how current is rectified by a mercury-arc rectifier. The characteristics of this rectifier are such that current can flow only from the carbon electrodes to the mercury pool, but not from mercury pool to the carbon electrodes, which gives the current flow indicated by the arrows.

Grid-controlled electronic devices, in any of the various forms described, may be used to invert from dc to ac, by the proper circuit arrangement.

In common with other electronic equipment, mercury-arc rectifiers are current devices. Hence, their capacity, for a given physical size, varies almost directly with their voltage, within certain limits. The chief loss is that of the arc drop, which is also a function of the current and practically independent of the voltage. From this it follows that the mercury-arc rectifiers compare favorably at 600 volts dc, with motor-generator sets or rotary converters, as regards both size and efficiency.

The photo tube is a very important member of the family of electronic devices. In this case, electrons are caused to be emitted from the cathode by light, rather than by heat. The photo tube may be either high-vacuum or gas-filled, the latter having better sensitivity. With a given voltage between anode and cathode, as in Fig. 10, the amount of current which flows is very nearly directly proportional to the amount of light falling on the photo-sensitive surface.

By using different materials for coating the cathode, the photo tube may be made sensitive to any desired color, which makes it suitable for color-matching purposes. Where desired, it may also be made sensitive to wave lengths outside the visible spectrum, that is, infra-red, or ultra-violet. Of course, the currents obtained from photo tubes are very feeble and would be of no particular value without amplifier tubes to convert them into usable form. The photo tube has opened up a host of applications for counting, scanning, or for control of any operation where it can be accomplished by interrupting or reflecting a beam of light. It is the most popular of any type of electronic tube for industrial use.

Photo-Glow Tubes

Photo-glow tubes are similar to gas-filled photo-tubes but that gas pressure in the former is considerably higher. They are operated with sufficient voltage between electrodes so that the electron flow due to the photo-electric effect will ionize the gas and initiate a glow discharge. The current through the photo-glow tube is not proportional to illumination. Since the flow has the characteristics of an arc with a constant-arc voltage, the amount of current passed in the glow discharge is limited only by the impedance in series with the tube. This current is of sufficient magnitude to operate a magnetic relay without amplification. The photo-glow tube passes unidirectional current, and consequently dc relay may be operated by the current passed from an ac supply.

There are two general types of grid-glow tubes: the cold-cathode and the hot-cathode designs. The latter is fundamentally the same as a Thyratron, about the only difference being in structure and current-carrying capacity. Hot-cathode tubes can in some instances be used as rectifiers and for controlling fairly large amounts of power. Cold-cathode tubes are primarily useful as relays and ordinarily find application as control devices.

How to Cure Unstable Boilers

What makes a boiler unstable? What does instability do? How can instability be cured or avoided? Here are the answers

By H M SPRING

BOILER STABILITY is a vital factor in design, installation, and operation. An unstable boiler may show slight trembling at a local point, as at the steam nozzle, or, in severe cases, the entire setting may rock back and forth. Or, if the factors affecting stability are not vibratory, the boiler may settle at one or more points.

The shell or drum, heads, braces and other parts are proportioned and fabricated to resist the maximum allowable steam pressure with a definite factor of safety. Creation of stresses beyond those imposed by pressure and normal expansion reduces the factor of safety and may lead to serious and dangerous complications.

Indications

One of the first indications of an unstable boiler is a chronic tendency to gasket leakage in the main steam piping. Leakage from threaded or flanged connections of other boiler piping, such as water-column connections, feedwater system, blowdown piping, etc, is another symptom. The piping may develop a dangerous whip in cases of vibratory instability, leading to serious failures (Fig. 1). In addition to piping failure, damage to the boiler at the point of connection may result.

Fatigue produced by continued vibration may cause rivet-hole fractures in the steam nozzle (Fig. 2). A limited number of these cracks does no harm, provided they do not extend out of the neutral sheet into the solid plate. However, continued stressing may cause serious extension.

Further boiler damage sometimes occurs at points where supporting members are attached. A vibratory condition may crack boiler plate between rivet holes; this is dangerous (Fig. 3).

Where a long-continued pulsating motion exists, chafing of the boiler against the brickwork may result in external damage. This condition is not common, but if it should develop it may go unnoticed at an inaccessible point. In addition to damage to the boiler itself, such reciprocating motion may seriously damage foundations, sidewalks, and other refractory.

A recently installed hrt boiler was supported by brackets on the brick walls. When faulty steam-piping design caused instability, the sidewalls broke from top to bottom through their entire thickness under the middle buckstay (Fig. 4). The boiler and entire setting had been pulsating due to steam-pipe reaction. The condition was partially relieved by the break, but the rear half of the walls became stable and acted as a fulcrum, while the front end of the boiler and the front half of the walls pulsated worse than ever. Changes in the steam piping, use of an additional pair of buckstays, and sealing the walls cured this condition.

The foregoing troubles resulted from vibratory instability. Slightly less alarming to the sight is passive instability, but the results may be equally serious. A boiler may settle gradually at either end, or roll over to one side, due to a sinking foundation or to a buckling support. The stress reversals of vibratory motion are absent and fatigue cracks are less likely. But a severe and mounting stress may be imposed on the piping or boiler until some part of boiler or setting collapses. There are safer places than a boiler room with a main steam line rupturing under pressure, or with a falling boiler breaking connecting piping on its way.

In addition to breeding danger of accident, an unstable boiler is almost certain to cause many cracks in the setting. Air infiltration means distinct operating losses. The combustion chamber may be cooled below the ignition temperature with resultant incomplete combustion, or dilution of the products of combustion through the various gas passes will reduce gas temperature and thus lower rate of heat transfer.

Instability of a boiler installation

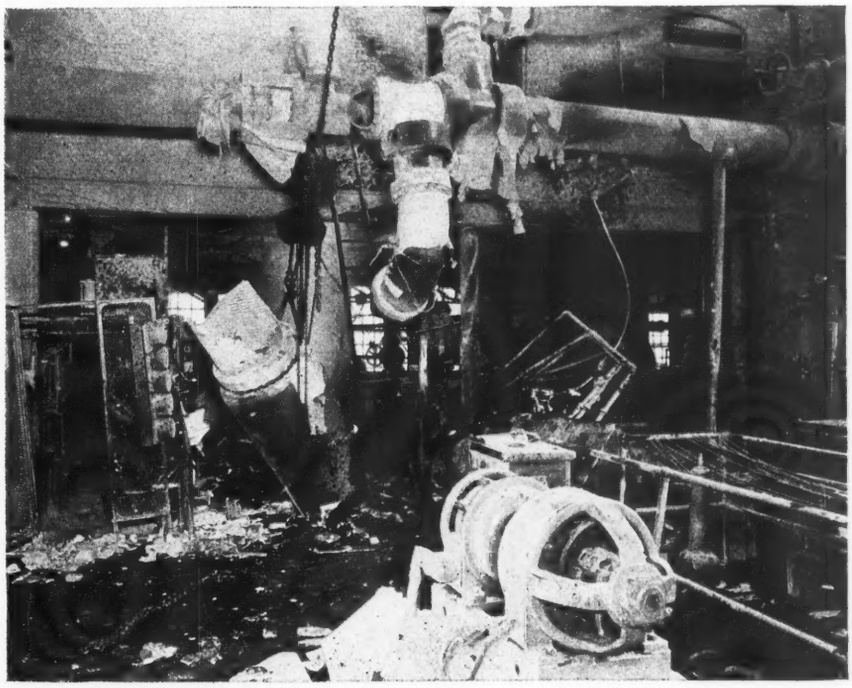


Fig. 1—Vibratory instability at the boiler caused this piping failure

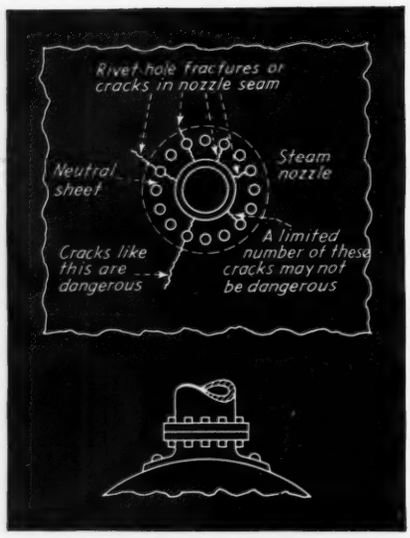

Rivet-hole fractures or cracks in nozzle seam
Steam nozzle
Neutral sheet
A limited number of these cracks may not be dangerous
Cracks like this are dangerous

Fig. 2—Riveted steam nozzle viewed from inside boiler drum

may be traced usually to one or more of the following:

1. Inadequate foundation
2. Excessive unit pressure of soil loading
3. Unrigid supporting structure
4. Steam pipe reactions caused by: inadequate capacity, too many directional changes, improper anchorage
5. Pulsating combustion
6. Mechanical vibration transmitted from an outside source through piping, supporting structure, or foundations
7. Improperly adjusted or overloaded engine
8. Steam space of boiler too small for pulsating demand
9. Harmonic vibration

The first three reasons and the eighth usually result from faulty design and usually cannot be corrected in existing installations unless operating conditions are changed.

In designing steam piping to avoid vibratory reactions, the major aim is to use diameters large enough to steer clear of excessive velocities. A maximum velocity of 10,000 fpm is recommended for steam piping between boiler and header. The Crane Co considers the following velocities reasonable in main steam lines: 4000–6000 fpm for saturated steam up to 15 lb per sq in.; 6000–10,000 fpm for high-pressure saturated steam; and 7000–20,000 fpm for high-pressure superheated steam. Research has shown the lower range of velocity for steam flow at 15 lb advisable for small pipe diameters and the higher limits acceptable for piping larger than 12-in. in diameter.

To select the proper size pipe, use the formula:

$$D = 12\sqrt{\frac{C}{0.7854\,F}}$$

where D = required diameter of pipe in inches
C = steam flow in cu ft per min.
F = steam velocity, in ft per min.

Suppose you want to select the right size pipe for a flow of 12,000 lb per hr of saturated steam at 300 lb and 10,000 fpm. First find from the steam tables the density for the pressure. For 300-lb pressure, the density is 0.67 lb per cu ft, so

$$\frac{12{,}000}{0.67} = 17{,}950 \text{ cu ft per hr} = 299 \text{ cfm}$$

$$D = 12\sqrt{\frac{299}{0.7854 \times 10{,}000}} = 2.34$$

Since it is customary to go to the next larger standard pipe size, 2½-in. pipe would be used.

Reaction of steam piping to pulsating flow is a complex problem, involving a multiplicity of factors. These include the pipe size, steam flow, rate of change in flow velocity, frequency of pulsation, mass, number and radius of turns, etc. There is no set rule for such installation. If the layout is large and costly, the experience of a well-known pipe fabricator and designer is essential. Otherwise, a satisfactory installation can be obtained only by "cut-and-try" methods which may prove dangerous or unnecessarily expensive. As a general rule, it may be said that a few wide sweep bends are to be preferred to a number of sharp bends when flow pulsates (Fig. 5).

Anchoring of boiler piping is important. Too often a main steam line is "tied up" from overhead structures and lateral anchors dispensed with. Pulsating flow then may cause a reactive, swinging, reciprocating motion, which is transmitted to the boiler. The anchors should serve two definite purposes: support the weight of the piping, and support it rigidly (taking care not to restrict expansion) so that reactive motion is controlled.

Combustion of fuel oil sometimes causes destructive vibration of boiler settings under adverse operating conditions; that is, when the reciprocating pump creates pulsations in oil flow. The flame burns with a fluttering appearance and sound. Vibration in the combustion chamber, breeching, and setting may affect the entire boiler. The cure for difficulties of this nature is to install an air-oil cushion tank (Fig. 6). This cushion absorbs the peaks of oil pressure, thus steadying the flow.

Mechanical vibration may be transmitted to a boiler or boiler setting through piping, integral foundations or integral steel structures. However, it is seldom practical to approach this problem with a view to altering the transmitting member. The best bet is to correct the vibration at its source. Causes

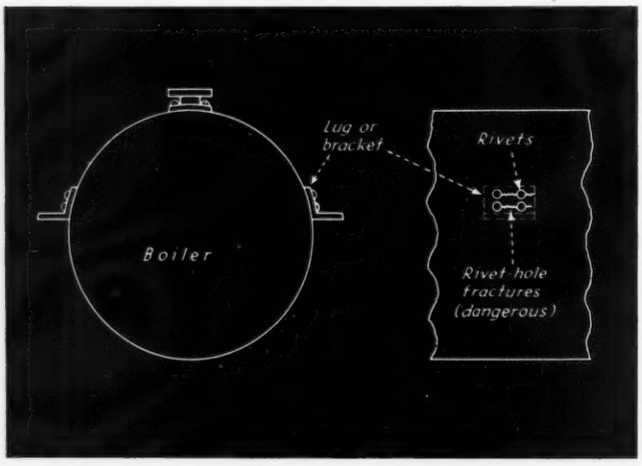


Fig. 3—Rivet-hole fractures at supporting brackets

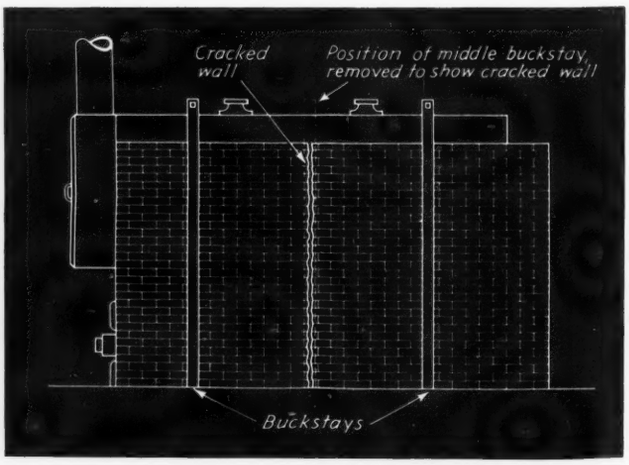


Fig. 4—Vibration crack in hrt boiler sidewall

of such vibration might include an unstable steam engine transmitting its oscillating motion back through rigid piping, or an unbalanced steam turbine might affect the boiler in a similar manner. It is unwise to include heavy reciprocating or rotating machinery on the same foundation as the boiler. Similarly, it is poor practice as a rule to tie up the supporting members of such machinery with the steel structure supporting the boiler.

Load Engine Properly

Even though piping, foundations, and steel structures be designed correctly, a steam engine may be operated in a manner that may cause boiler instability. The load on the crank-end and head-end should be divided evenly by valve adjustment. Use of an indicator is essential for setting the valves properly to achieve this. Heavy overload on an engine may make it operate with delayed cut-off and draw steam for almost full stroke. This condition, too, is a frequent cause of pulsation which is transmitted back through the steam piping.

Design of certain boilers has limited the steam-storage capacity to such an extent that pulsating flow causes corresponding fluctuation of steam pressure. Instantaneous steam demand produces a pressure drop. When flow slacks off, boiler water at the lower

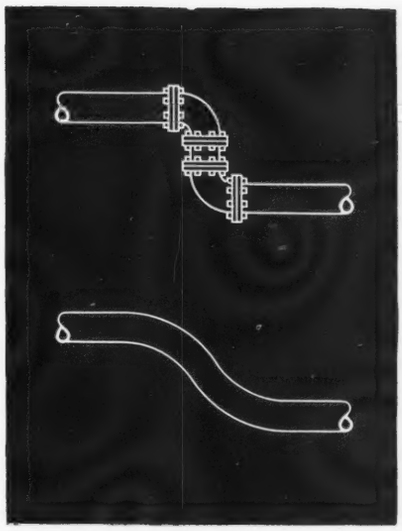


Fig. 5—Short turns give trouble with pulsating flow; sweep bends are better

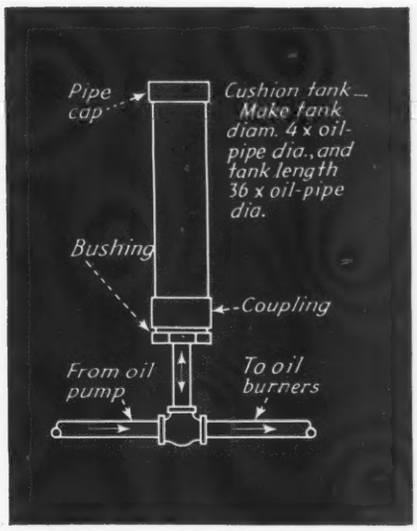

Pipe cap
Cushion tank—Make tank diam. 4 x oil-pipe dia., and tank length 36 x oil-pipe dia.
Bushing
Coupling
From oil pump
To oil burners

Fig. 6—Cushion tank for damping pulsations in piping from oil pump to burner

pressure flashes to steam, bringing the pressure up again. If small steam-storage capacity makes a boiler unstable, about the only solution is to change the load conditions by reducing frequency or intensity of the pulsations. An accumulator might be inserted in the steam line to provide additional storage.

Harmonic vibration of a boiler in sympathy with an external vibration is not common. It sometimes occurs through mechanical means and it may be reduced or eliminated by adding mass to the boiler. This may be done by installing a row-locked set covering of red brick on the boiler top. The strength of the supporting structure should be checked for added weight before proceeding with such work. For example, this covering on a 72-in. x 18-ft boiler weighs about 5 tons. The supporting structure should not be stressed so much as to lower the factor of safety below 8, with the total weight of the brickwork, attachments, and boiler full of water.

Exhaust Lines

By L N ROWLEY

Some people seem to do outstanding things by accident. Swedish engineers wanted to interconnect hydro networks in different parts of the country so that when northern streams are frozen, power can come from southern streams swollen with autumn rains, and when water is low in the south, melting rains in the north can carry the load. The connections were made, and one of the results was the creation of what must be close to the world's longest transmission system. From the most northerly station, Porjus in Lapland, to Copenhagen, connected with the Swedish system by submarine cable, is just about 1000 miles.

Diesels will play a major role in the exploration of the Antarctic, if the projected "Snow Cruiser" matches up to expectations. Designed by Dr Thomas C Poulter of the Research Foundation of Armour Institute of Technology, this unique vehicle will be the main cog of the Government-sponsored Antarctic expedition getting under way next year. Costing about $150,000, the Snow Cruiser will be 55 ft long, with 10-ft rubber-tired wheels, and will carry a 5-passenger plane. Each of the four huge wheels will be driven by an electric motor supplied from two diesel-electric power plants. Its cruising radius of 5000 miles, speed range of 10 to 30 mph, ability to span crevasses up to 15 ft wide and extreme maneuverability should make it equal to any terrors the Antarctic may hold.

Lubrication problems of power engineers seem simple compared to those of the puzzled reader who asked "Esso Oilways" to recommend a suitable petroleum product for oiling his hogs. Without specifying whether crankcase, chassis, or rear-end lubrication was under consideration, the questioner went on to indicate that the product had to be capable of preventing ticks and other small pests which infest the skins of these animals during summer. The editors, apparently as familiar with porkers as with petroleum, suggest two kinds of water-resistant, adhesive greases and go on to say that the grease may be applied by hand or by means of a hog-greasing device. Our admiration for the engineering skill that could devise a piece of labor-saving machinery like a hog-greasing machine, can't quite overcome our regret at the apparent eclipse of that fine old art—hog greasing by hand.

Just one hundred years ago, Isaac Babbitt, of Boston, patented the method of bearing lining that bears his name. This little-known contributor to mechanical progress once manufactured and sold "brittania ware" and the knowledge of white-metal alloys gained in his early business venture came in handy when he tackled the bearing problem. The original patent specifications mention a composition of 50 parts tin, 5 parts antimony and one part copper, but Babbitt was careful to say he didn't intend to limit himself to this one alloy, and now the term "babbitt" covers a wide range of white metals used in industry.

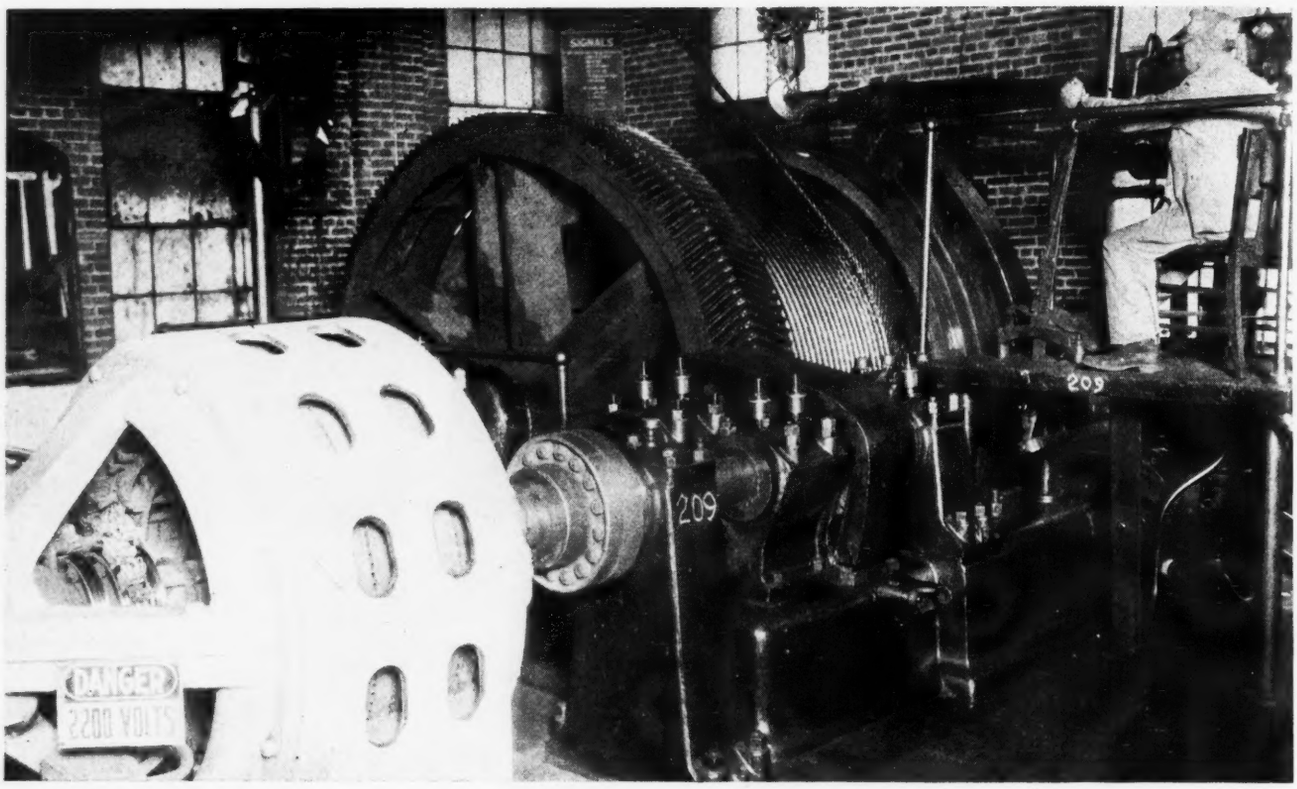


Fig. 1—For safe, economical service, wire rope on every type of hoisting equipment should be properly lubricated

How and When to Lubricate Wire Rope

By A J MORGAN
Chief Engineer, Wire Rope Div
John A Roebling's Sons Co

A WIRE ROPE is a machine with many moving parts, and like any machine, proper lubrication is vital. If you try to save by skimping on lubrication, you'll get reduced rope life and increased accident hazard.

Abrasion and broken wires observed by surface inspection indicate remaining strength in wire rope. It is possible and practical to set up an inspection procedure to approximate closely remaining strength of wire rope, provided that corrosion is not a factor. But, if corrosion is present, any rules or data which normally can be used as a guide will be inadequate and unreliable.

Corrosion occurring inside the rope is often very hard to detect. This is sometimes due to the character of lubricant used. It may not penetrate the rope properly, gums the outside, seals in any moisture present in the rope, and prevents observation of the rope's condition insofar as corrosion is concerned.

If you thoroughly clean the valleys between wires and strands and find slight pitting or rusting at the points where strands make contact, it is very probable that corrosion is going on inside. How far this corrosion has progressed is extremely hard, if not impossible, to determine. Generally, where internal corrosion exists, the strands are closely locked and not free to move. This condition indicates that the hemp center had become too small, probably because the hemp has deteriorated. Lack of proper lubrication is usually responsible for this.

Wire rope is made up of a number of strands. Each strand consists of 7 to 37 or more wires. When a wire rope flexes around a sheave or drum, each wire in a strand and every strand in the rope must move in respect to its companions if the rope is functioning properly. This means that there are at least 42, and as many as 222 or more, moving parts.

Every wire can bear against three or more adjacent wires for its entire length. These bearing surfaces are very narrow, in fact, are tangent lines of cylinders when new, but they represent definite bearing areas. Naturally, these bearing areas are subjected to extreme pressures created by tension in a rope as it passes over a sheave or drum. Thus, proper lubrication of any wire rope insures safety of operation and reduces internal friction with a resulting increase in useful life.

Lubrication of wire rope is initiated during manufacture and then carried on in service. During manufacture, there are three principal parts to be considered: the hemp center, the strands, and the rope as a whole.

There are a number of points of

difference in the various practices and opinions held by manufacturers. The primary object of any method used is to place a suitable amount of lubricant, or protector, in the hemp center. This can be done in a number of ways, a few of which are: boiling in lubricant, exhausting all air and filling the hemp with lubricant under pressure, thoroughly impregnating the fibres with lubricant during manufacture of the hemp center.

Strand Lubrication

Lubrication of the strands can be done in several ways, either during fabrication or by application of proper lubricant to the finished strand. Comparable results can be obtained by various methods, but there are differences of opinion as to the types of lubricants to be used. In the final analysis, however, it is agreed that the strand must be internally lubricated. The choice of lubricant is largely limited by the duty for which the rope is intended. Lubricants used in strands today include various types and weights of oils and greases, and blends of oils and greases with protector compounds.

Changing requirements have made it necessary to fabricate an increasing number of ropes to meet specific operating conditions, and to provide the most economical service for each field of application. This applies to all phases of wire-rope manufacture, including lubrication. However, even with the excellent lubricants and methods of application in use, the one application made by the manufacturer can't last the life of the rope. If the user will establish a good rope-lubrication practice in addition to properly maintaining the equipment on which it operates, safe and economical service will result.

A good lubrication practice is one of the essential parts of any maintenance program, but it is difficult to set up a program equally effective in all cases. The object of any field practice should be twofold: to lubricate the rope, being certain to obtain penetration to the hemp center; and to protect the rope against any agent of corrosion.

Clean Rope Surface

The first step is to clean the surface of the rope, if necessary, with compressed air or superheated steam, or a combination of both. Equipment required for this can be simple, or well developed for maximum efficiency, Fig. 3, according to requirements of the user. The important thing is: have the rope as clean as possible before applying the fresh lubricant. In the curved pipes, Fig. 3, drill 1/8-in. holes so that the air or steam jets will strike the rope at equally spaced points. For rope 1 in. in diameter and smaller, drill 6 holes; up to 1.5 in. in diameter, drill 8 holes; over 1.5 in. in diameter, drill 10 holes.

The choice of suitable lubricant for field use may be somewhat different than that used in the manufacture of the rope. It is not always possible to obtain thorough penetration in field applications, particularly with the heavier lubricants and protectors. However, there are a number of good lubricants available which can be applied with reasonable thoroughness, if proper methods are used. Equipment necessary for field lubrication, and methods by which this work is done, will depend, at least to some extent, upon the type of lubricant applied.

Oiling Devices

Generally, heavier lubricants and protectors are applied (usually hot) by running the rope through the lubricant in a trough or lubricating box of some type. Lighter lubricants can be applied by hand, using a brush or swab, Fig. 4, or even by a drip lubricator for the very light oils.

A simple equipment for applying lubricant to a vertical wire rope is shown in Fig. 2. It is made of two timbers bored as shown, with a sheet of leather tacked to the funnel-shaped opening to fit the rope snugly. Before boring, the timbers should be fitted together so that there will be no oil leakage between them. In use, the device is placed around the rope, bolted together and fastened to the head-work frame under the head sheave on the shaft side. Waste or packing should be pressed into the tapered portion of the lubricator to prevent leakage. The lubricant is then poured into the receptacle and constantly replenished as the rope is slowly lowered into the shaft. Lubricating of the rope should be done without load in the car or cage.

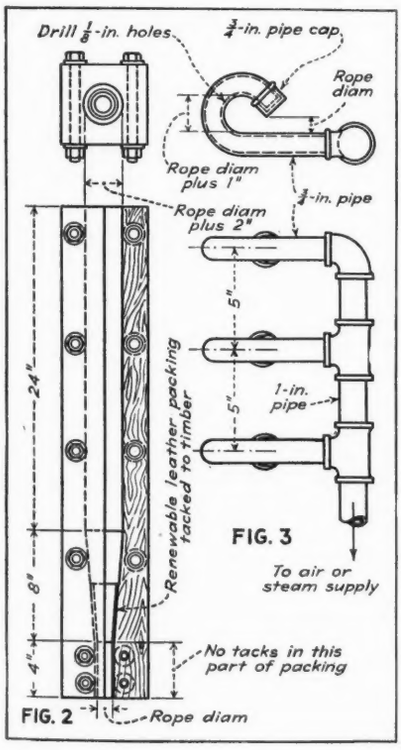


Fig. 2—Device for applying lubricant to shaft hoist ropes. Fig. 3—Shaft-hoist rope cleaner made of pipe, for use with air or steam.

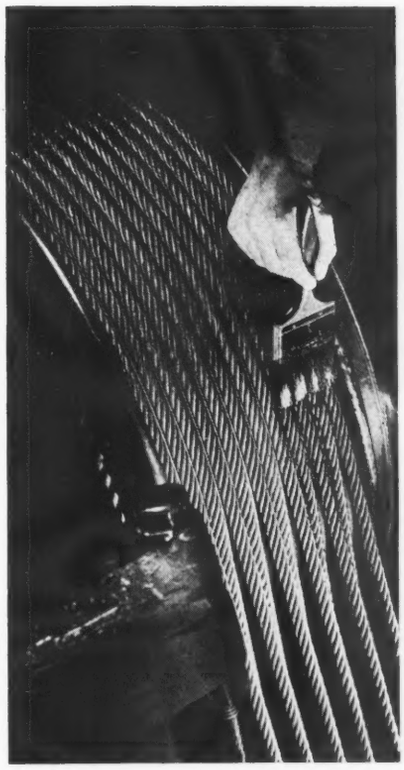


Fig. 4—Light lubricants may be applied to ropes by hand, using a brush or swab

Lubrication Practices

Because of the multiplicity of lubricants, methods of application, and lubricating devices, space does not permit a full discussion of them here. It is suggested, however, that all wire-rope users who do not have an established lubricating schedule and practice developed for their installations, should consult with lubricant and wire-rope manufacturers and avail themselves of the knowledge and experience of these specialists.

Manufacturers are building wire ropes to give maximum service. For safety and economy, wire ropes must be properly lubricated with a good grade of wire-rope lubricant. It is a known fact, established through practice and experience over a period of years, that wire ropes can and should be lubricated in the field.

Gas Welds in Heavy-Wall Pipe

New single-flame multi-layer technique assures quality welds by average operators. Here is how to go about the job, how many layers to put on and how long it takes

By M R SCOTT
The Linde Air Products Co

FOR GAS WELDING heavy-wall industrial piping, a new technique, known as single-flame multi-layer, has distinct advantages over previously used methods. The process is not only economical and easily mastered by average operators but produces welds of sound quality and high ductility which readily fulfill code requirements.

The two general methods at present used in the oxy-acetylene welding of pipe are (1) neutral-flame, forehand technique and (2) backhand welding with an excess-acetylene flame. The new technique for the multi-layer welding of pipe might be described as a combination of these two, employing the neutral flame of the former with the backhand technique of the latter.

Depositing the weld metal in layers has two advantages over single-layer welding. First, the average operator is less likely to find laps and inclusions in the finished welds and, second, the ductility of the first layer is increased by the normalizing or grain-refining action produced as additional layers are laid down. Tests in both laboratory and field show that multi-layer welds are consistently more ductile than single-layer welds.

The simplicity of the single-flame and backhand techniques are further reasons why the process requires no special operator training. The single flame is most widely adaptable for making the variety of rolling welds, position welds, and horizontal-vertical welds usually found in a piping installation. The operator does not have to have the greater skill necessary for manipulating the multi-flame tips. By learning the fundamentals of the single-flame technique, he will be able to handle all types of position welds as well as any rolling welds encountered in a piping job.

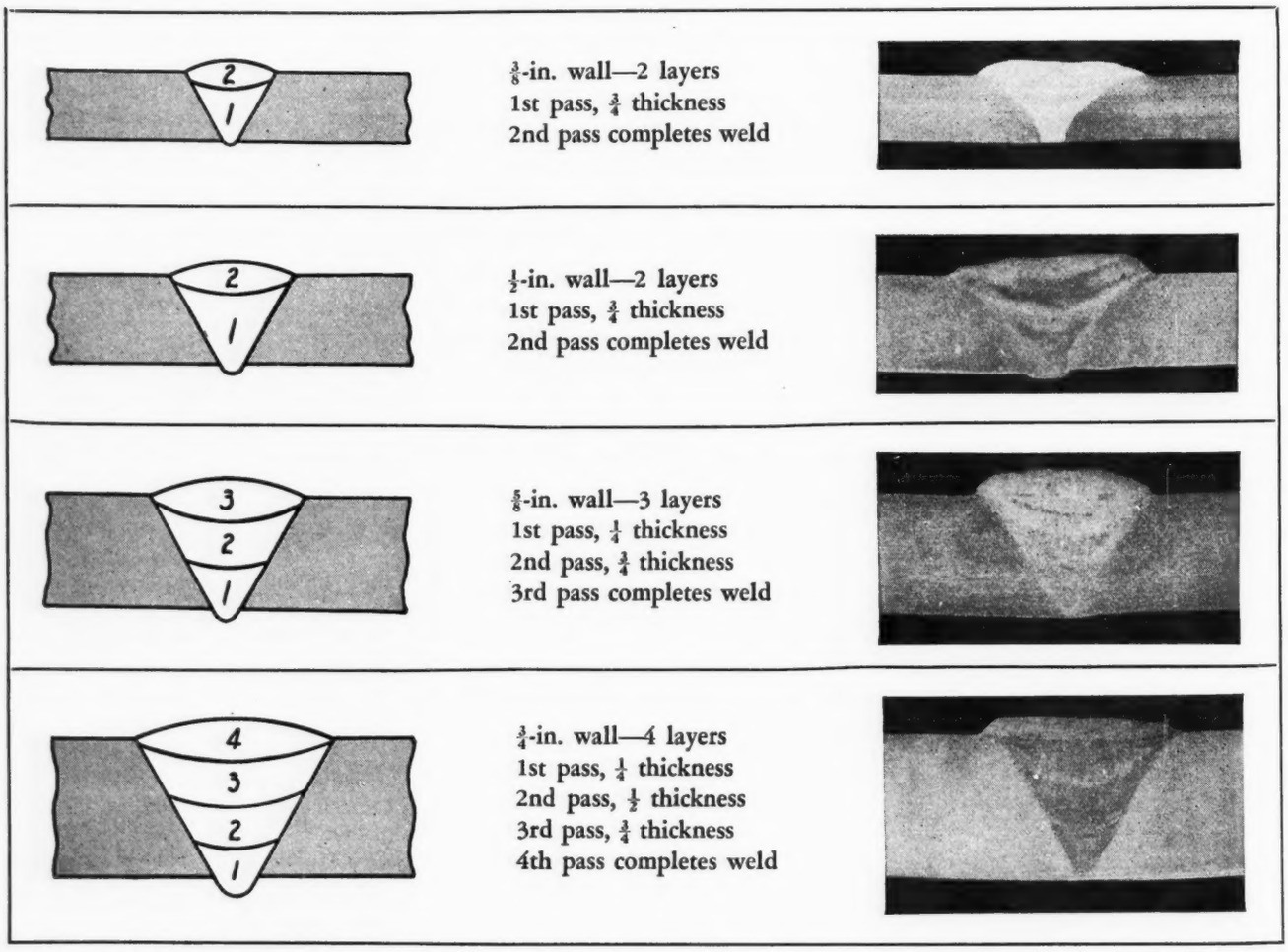


Fig. 1—Correct layer thickness and contour of weld at left. Macrographs show etched cross-section of the finished welds

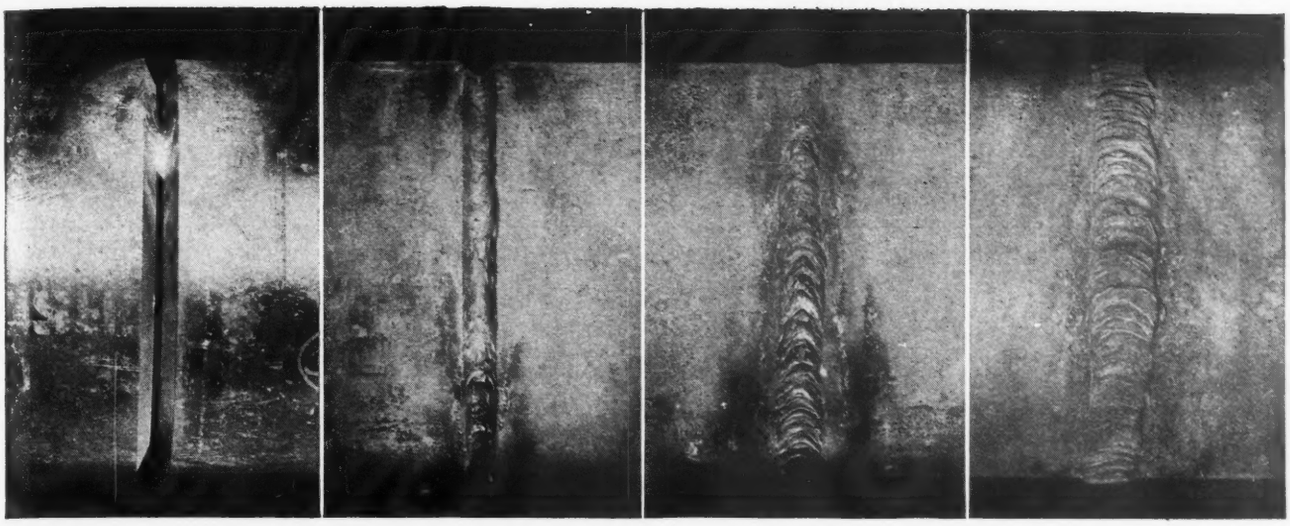


Fig. 2—Steps in the multi-layer welding of 8-in. pipe with ½-in. wall thickness. Left to right: tack-welded, first layer deposited, second layer deposited, and completed weld showing third layer

The backhand technique makes it easy for the operator to control the molten weld metal regardless of position, pipe size, or wall thickness. In addition, each layer can be laid to such a contour that no chipping is necessary before applying the next layer.

Specifications for welded piping have been set up by a number of organizations among which are American Society of Mechanical Engineers, American Standards Association, American Petroleum Institute, American Society for Testing Materials and American Welding Society. These standards, or specifications, require qualification of both operator and process. While there is some variation among the several codes, they are essentially alike.

For the qualification of the process, the joint must be made in the positions encountered in the actual construction and welding must be done in accordance with the particular specifications. Results of numerous tests show that multi-layer welds, made with the single-flame backhand technique, have physical properties equal to or better than those required by these codes.

Multi-layer welding is recommended for pipe-wall thicknesses of ⅜-in. and over. As shown in Fig. 3, a 60-deg angle with approximately 3/32-in. shoulders is recommended for all sizes of pipe.

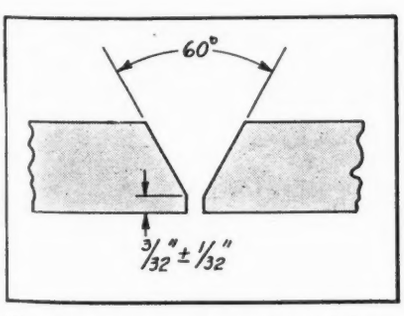


Fig. 3—A 60-deg angle with full 3/32-in. shoulder is recommended

TABLE I—RELATIVE IMPORTANCE OF AIDS TO PUDDLE CONTROL

Factors restraining effect of gravity	Welding Position			
	Flat	Vertical	Over-head	Horizontal-vertical
Weld and base metal dam...	1	4	4	2
Flame dam.....	2	1	2	4
Surface tension of puddle....	3	3	1	3
Rod manipulation.....	4	2	3	1

The angle of bevel is important because it has a definite effect on the ease, quality and cost of welding. Formerly, joints with included angles as large as 90 deg were used. Since the introduction of the backhand technique, the trend has been toward the narrower vee and consequent greater ease of welding. In fact, in the heavier-wall thicknesses, skilled operators can obtain excellent results with a 50-deg included angle. Average operators will find the 60-deg angle preferable for the general run of work.

If shoulders are omitted, the feather edge melts away during welding, thus, in effect, destroying the spacing. In addition, the beveled edges are apt to become damaged during shipping or moving the pipe.

Edges of butt joints should be separated a sufficient amount before tack welding to provide for contraction of the tack welds and to insure an average spacing of 3/32 in. during the welding operation. Too large a spacing increases rod consumption and sometimes makes the welding more difficult. Too small a spacing makes more difficult the securing of fusion to the bottom of the vee. Large-size piping requires slightly larger spacing, for example, 14-in. pipe and over should be spaced about 1/16 in. before tack welding.

Size of rod depends somewhat on the skill of the operator. As a general rule, use the largest size rod that can be readily handled. This prevents overheating the puddle and allows better control in using the rod as a means of regulating puddle temperature. However, with large rods, there is always the danger of an inexperienced operator depositing metal in the semi-plastic condition. A 1/8-in. rod is a good average size for multi-layer position welding of wall thicknesses from ⅜ to ¾ in.

Type of Flame

A neutral or very slight excess acetylene flame should be used for multi-layer pipe welding. Although a neutral flame is preferred, a slight excess of acetylene increases the ease of welding without a noticeable loss in the ductility of the welds.

For most work, a soft, low-velocity, bulbous flame in a large tip is recommended for position welding. Tip size is dependent on wall thickness and rod size and should be determined after the other variables have been fixed. In

TABLE II—SPEED AND CONSUMPTION FOR MULTI-LAYER WELDING OF 8-IN.* HEAVY-WALL PIPING

Type of weld	Pipe size Diam., in.	Pipe size Wall, in.	Bevel, incl. angle, deg.	No. of passes	Rod size used in each pass, ** in. 1	2	3	4	Tip used for each pass, *** No. 1	2	3	4	Consumption per weld, cu ft Oxygen	Acetylene	Rod used, lb per layer 1	2	3	4	Total	Welding time, min. per layer 1	2	3	4	Total
Rolling	8	3/8	60	2	3/16	3/16	—	—	10	10	—	—	19	19	0.47	0.50	——	——	0.97	9	15	—	—	24
	8	1/2	60	2	3/16	1/4	—	—	12	11	—	—	33	33	0.71	0.73	——	——	1.44	14	16	—	—	30
	8	5/8	60	3	3/16	3/16	1/4	—	12	12	12	—	67	67	0.47	1.10	0.81	——	2.38	15	17	21	—	53
	8	3/4	60	4	3/16	3/16	1/4	1/4	13	13	13	13	119	119	0.56	0.86	0.89	1.20	3.51	16	24	20	22	82
Position	8	3/8	60	2	3/16	3/16	—	—	11	10	—	—	31	31	0.47	0.75	——	——	1.23	14	20	—	—	34
	8	1/2	60	2	3/16	3/16	—	—	12	11	—	—	54	54	0.56	0.97	——	——	1.53	20	30	—	—	50
	8	5/8	60	3	3/16	3/16	3/16	—	12	12	11	—	86	86	0.52	1.12	0.62	——	2.26	22	24	30	—	76
	8	3/4	60	4	3/16	3/16	3/16	3/16	13	13	13	12	164	164	0.70	0.75	1.32	0.85	3.62	26	28	30	40	124
Horizontal-Vertical	8	3/8	60	2	3/16	3/16	—	—	11	10	—	—	22	22	0.48	0.55	——	——	1.03	9	17	—	—	26
	8	1/2	60	2	3/16	3/16	—	—	12	11	—	—	34	34	0.45	0.86	——	——	1.31	13	18	—	—	31
	8	5/8	60	3	3/16	3/16	3/16	—	12	12	11	—	87	87	0.56	0.71	1.22	——	2.49	18	26	24	—	78
	8	3/4	60	4	3/16	3/16	1/4	1/4	13	13	13	12	168	168	0.49	0.52	1.10	1.35	3.46	18	22	38	52	120

* Data for pipe sizes other than 8-in. can be obtained by multiplying rod and gas consumptions and speeds by the ratio of the diameters.
** Oxweld No. 1 High Test steel welding rod. *** Oxweld W-17 or W-22 blowpipes.

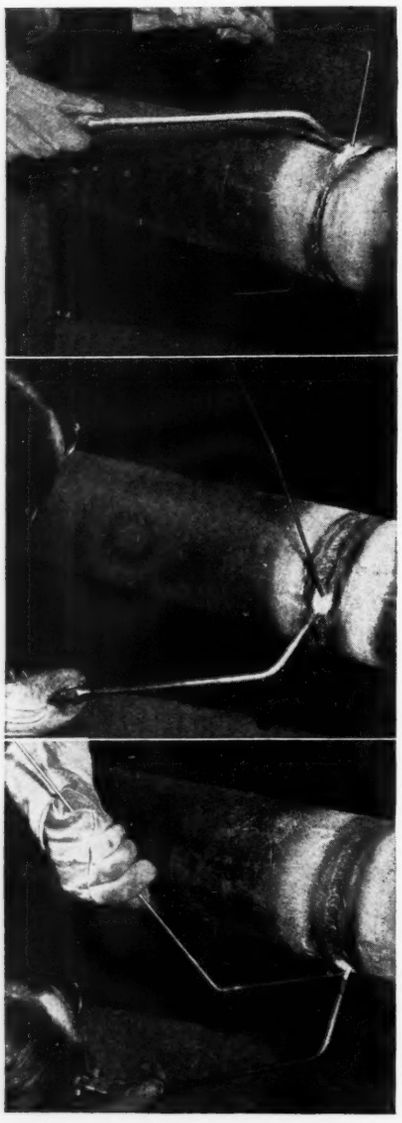


Fig. 4—Positions of rod and blowpipe for flat, vertical and overhead welding

general, tip size ranges from No. 10 for 3/8-in. wall to No. 13 for 3/4-in. wall.

Tack welds should serve two purposes (1) to maintain the desired distance between abutting edges and (2) to permit longitudinal alignment of the pipe. Tack welds require very little strength and are commonly made far larger than required. Most are too deep, too long and too numerous. All that is really needed on an 8-in. pipe for instance, are three equally spaced tack welds one inch in length and half the wall thickness in depth. The edges, however, should be concave and well fused to the base metal.

As pipe welding in general, and position welding in particular, involve welding in all positions (flat, vertical, overhead, and horizontal-vertical), a thorough knowledge of the factors which permit control of the weld metal in these positions will aid in the understanding of the multi-layer technique.

The most important force at work on the molten metal is gravity, and its effect must be restrained by one or more of four means (1) manipulating the rod in the molten puddle (2) damming the puddle with the flame (3) damming the puddle with cooled weld metal and base metal and (4) regulating the temperature and size of the puddle in such a way that its cohesiveness, or surface tension, will maintain it under control.

The relative effectiveness of these four aids to puddle control are listed

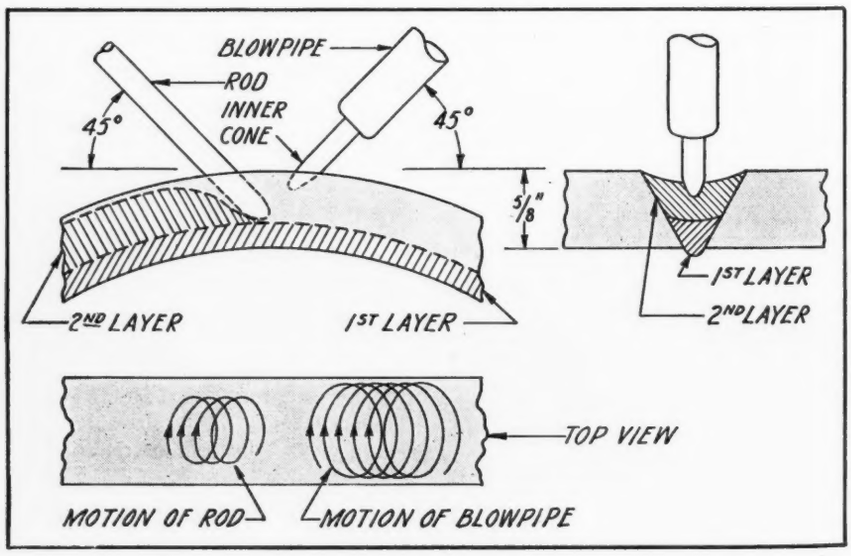


Fig. 5—In multi-layer welding, rod and flame are moved in a circular direction

in Table I in the order of their importance for each of the four welding positions.

When welding directly overhead, it is possible to maintain a surprisingly large puddle of molten metal if just one precaution is observed. Everyone knows that water or oil, sprayed lightly on the underside of a flat surface, will fall only after a complete drop has taken shape. Likewise, if the welding puddle is kept from forming into a drop, cohesion or surface tension prevents its fall. Overhead welding is not difficult if the pool of metal is kept small and not too fluid.

Vertical Welding

When welding vertically, as when bringing the puddle down the side of a pipe joint, the influence of surface tension in maintaining the puddle decreases. An amount of liquid that can be suspended on the underside of a flat surface will collect and run on a vertical surface. Consequently, the flame dam (pressure exerted by the burning gas) must be relied on to a considerable extent in maintaining a puddle of fair size. Vertical welding is the most difficult of all positions since the danger of laps and lack of fusion to the sides of the vee is always present. These effects can be minimized by carrying a shallow pool of metal through this position.

Horizontal-vertical welding (where the pipe is vertical and the joint horizontal) is probably second to vertical welding in the amount of skill required to make a satisfactory weld.

In making the weld, still using the backhand technique, the flame should be pointed ahead of the rod and should be directed mainly on the lower half of the vee. Weld metal should be built up along the lower side of the vee somewhat in advance of the upper side, thereby providing a shelf or ledge for the molten puddle which is flowed in a diagonal direction across the weld. The upper edge of the vee is not melted unduly and a good rate of speed can be maintained. Should the flame be pointed directly into the weld puddle, the tendency would be for the metal to collect in a large puddle at the bottom of the vee and then fall down the pipe side.

Fig. 1 indicates the correct layer thickness and contour for the multi-layer welding of various pipe-wall thicknesses. The first layer of a position weld should be made by starting at the top of the joint and carrying the puddle around the pipe to the bottom, then restarting at the top and completing the opposite side. Subsequent layers should be laid similarly until the weld is completed.

Concave Contour

It will be noted from the sketches that all base layers have concave contours, so that only a thin skin of weld metal requires fusing when subsequent passes are made. This is important as it provides the maximum desirable heat treatment without the necessity for refusing a large amount of weld metal, features which are desirable from both metallurgical and economic standpoints. The concave contour will also be found advantageous from the operator's point of view because the flame spreads evenly over the surface, bringing it uniformly to fusion temperature. On the other hand considerable skill and effort are required to fuse the surface evenly if an undesirable convex surface meets the beveled face.

Two practices should be avoided to prevent the formation of a convex head. These are (1) carrying an excessively large puddle of molten weld metal which cannot be fused in properly and (2) inadequate preheat in the base metal. These conditions can be overcome by directing more of the welding flame on the base metal rather than the rod and by preheating the vee a sufficient distance ahead. Both rod and flame should be moved in circular directions with the flame outlining slightly larger circles than the rod.

Cost Analysis

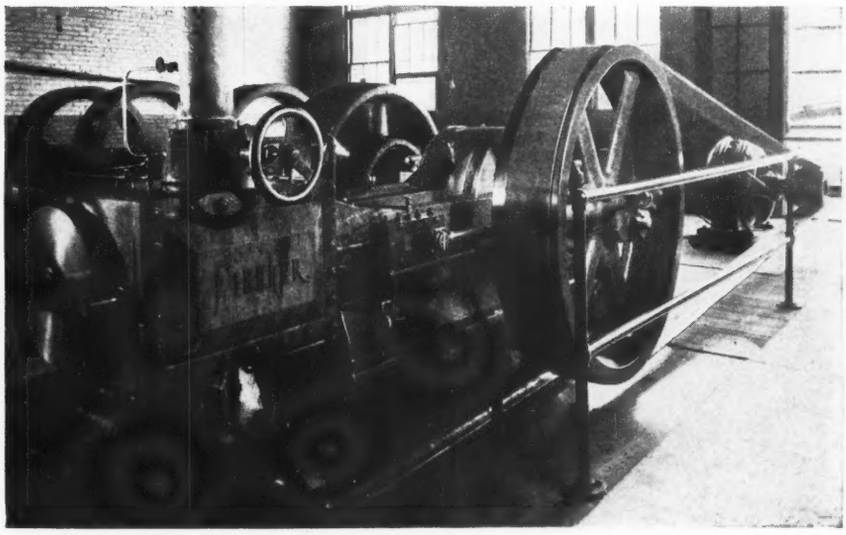
In Table II are listed welding speeds and rod-and-gas consumption figures for multi-layer welds in 8-in. pipe. The figures presented are for position welds, horizontal-vertical welds and rolling welds in wall thicknesses ranging from $\frac{3}{8}$ to $\frac{3}{4}$ in. The table is set up so that data for pipe sizes other than 8 in. can be readily obtained by multiplying speeds, rod or gas consumptions by the ratio of pipe diameters.

It should be emphasized that the results as set forth in this table were obtained by average operators who had average ability in all types of welding, but had not specialized in any one type such as heavy-wall-pipe welding. In other words, the figures are representative of what can be expected in the field with operators untrained in the multi-layer welding technique. Skilled operators can obtain speeds faster than those shown in the table.

✦ ✦ ✦

Eccentric Old Timer

THIS 12 x 12-in. double-valve double-eccentric Fischer has been on duty since 1900 and is still good for many more years to come. Now a standby unit at the Boston Insulated Wire and Cable Co in Dorchester, Mass, it has a slide valve on either side of the cylinder, each driven by a separate eccentric on the main shaft. To the original 37½-kw, 300-rpm direct-connected General Electric dc generator has been added a belt connection to another small generator. No foundation supports the 13,500-lb unit; it rests directly upon the floor.



Speaking of Power

Farm boy makes good. . . . Returning recently from the West, I found this note on my desk: "I began taking POWER about 28 years ago. It was a good magazine in those days. Then it started to get very technical and I gave it up. It used a lot of words I couldn't understand. They didn't teach us mathematics like that in my day. It was all right for the technical engineer, but I was just a farm boy. . . . Two years ago your man came around told me POWER had changed, so I gave him a year's subscription for a test. He was right. Yes, I noticed that Operating Engineer section. It's swell, I can figure it all out now."

Now that we have this man satisfied, we may begin to get kicks from the other end of the line. *Balance* is the editor's everlasting problem. He's either too technical or not technical enough, generally both at the same time. . . . But we think we have the answer now with

Balance is the problem

the Operating Engineer section, which is definitely down to earth and will stay there. It will ease our conscience when we run a few technicalities in the rest of the book. . . . That is, technicalities where they are needed; I don't expect that any part of POWER will go "high-brow" in a big way.

As we see it, the whole magazine, from one end to the other, is addressed to men who have actual jobs to do in the power field—who are not, as they say, "working for their health." Sometimes these practical jobs require a little theory, and sometimes they don't. Some readers are educated to understand theory, others are not. . . . Our purpose, in a nutshell, is to serve the truly practical men all the way up and down the line. In saying this, we concede that a good theorist may be a practical man, and that the practical job often requires a little theory.

I am much interested to hear that POWER's long-time friend, Edward H Barry, has opened a consulting office in Boston. Back

Versatile Mr Barry

in 1934 we ran a little editorial piece about Barry in connection with an article he wrote, and discovered then that he engages in enough vocations and avocations to keep a small-sized town busy. As I recall, we noted the fact that he was a licensed engineer, an inventor, amateur astronomer, exceptionally able musician, builder of a 6-in. reflecting telescope, author of a standard treatise on 3-cushion billiards, co-discoverer of a process for silvering optical glass, and that he had had extensive experience in the textile industry, as well as pulp and paper.

An editor's job is to recognize a good story when he sees one. There's no doubt that the Lansing, Mich., plant measures up in this respect (see page 56)

"High-class" power plants

—handsome stackless building, six stages of feed heating (first time in this country, we believe), 160-ft high single-pass boiler, reciprocating feed pump with hydraulic coupling. . . . In our opinion, it's a rare plant story that can't be told in four pages or less, if you know how. But every rule has its exception, and this time it's Lansing. It gets five pages, and we think you'll agree it's worth it. . . . Incidentally, the photo story on page 94 shows a European solution to one of the problems faced by the designers of the Lansing plant — building a power house that won't look out of place in a residential or high-class business district.

On page 61 you will find No. 2 of "Letters from a Turbine Specialist". The series started last month and will run nearly a year. Once I thought a turbine specialist was a man who knew all about turbine-generators. Not so, I now discover. Apparently, no one man is big enough to cover the

Turbine specialist

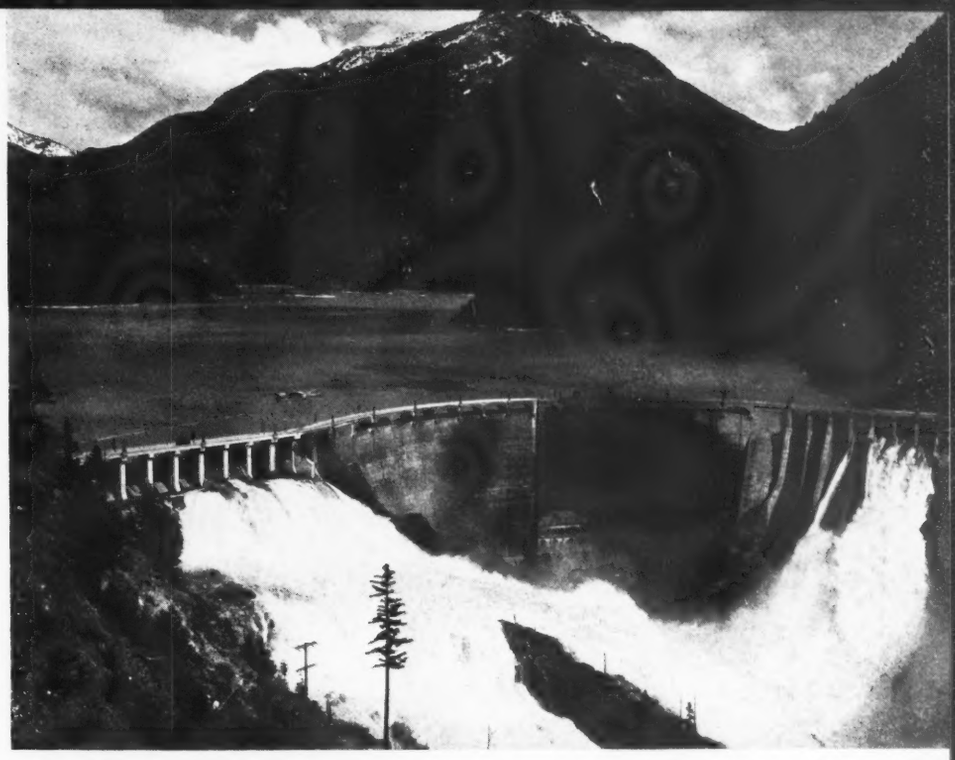
whole machine. So we must have one expert on the turbine end and another on the generator end. That's why no single man will answer all of the questions addressed to the "Turbine Specialist". . . . If this business of specialization continues, we may see the day when a man will carry on his business card the notation, "Turbine Specialist, Northwest Corner", or "Nozzle Expert, 150 to 225 Lb". . . . All kidding aside, turbine-specialist Kohl and his associates have got something. A man in the field has a problem. He can't take "I don't know" for an answer. Mr. Kohl gives him the straight dope as far as anybody can know. As editors, we pass this inside information along for any of you who might use it.

Besides knowing a good story when he sees one, an editor's job also consists in working enough ahead of schedule on "routine" articles to allow for type setting, proof reading, printing, binding, and acts of God. This can sometimes cause slight confusion and uncertainty, for as I write Speaking of Power for the October issue, it is August 24 and unpleasantly humid. By the time you read

Ahead of schedule

this, there will be a crispness in the air and topcoats will have been taken out for overhaul. . . . One of the editors, whose province it is to keep track of schedules and see that the rest of us get our stuff in on time, has for several years been infallible — he always could tell us whether it was last month, this month, or next, that an article was published or was going to be published. But it finally got him. . . . He told me the other day that an article couldn't go in the October issue because it was already "closed". Anyway, we're glad in August that it's October.—*PW'S.*

Northwest Scenes



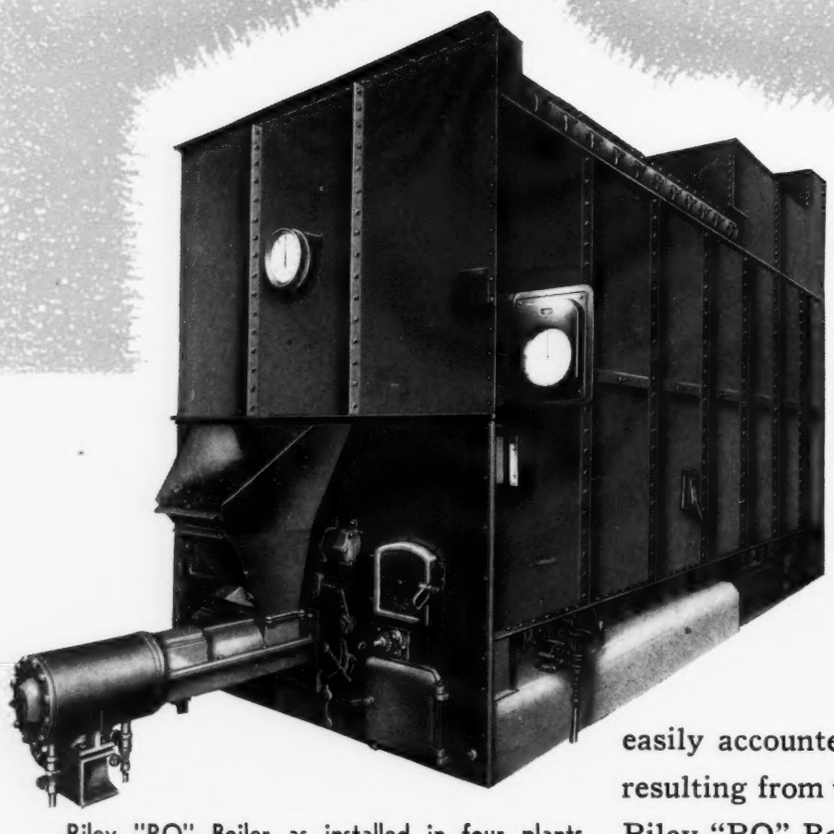
RETURNING FROM HIS TRIP to the Coast, Phil Swain selects these three pictures from his album of 200 photos as samples of things worth seeing and remembering in the Pacific Northwest. For further details see page 65.

Diablo Dam turns scenery into kilowatts for Seattle. The boat trip up this man-made Diablo Lake to Ross Dam, now nearing completion, is one of America's most scenic tours

On the tip of the Olympic peninsula, extreme northwest corner of the United States, lies Port Angeles, backed by snow-capped mountains. Here great plants convert timber into lumber and pulp

Canadian Rockies near Banff, seen on the homestretch from Vancouver to Montreal

Savings like these



Riley "RO" Boiler as installed in four plants of Pet Milk Co. Four different repeat orders.

Actual results in the field prove efficiencies from Riley "RO" Units are normally five per cent higher than efficiencies from ordinary brick set boilers. This is easily accounted for by lower flue gas temperatures resulting from the use of the integral economizer with Riley "RO" Boilers, by less radiation loss because of the use of water-cooled furnace with steel-clad insulated setting and by higher combustion efficiency made possible because of the water-cooled furnace.

You can make similar Savings in your plant by installing RILEY "RO" BOILERS

AT A NEW YORK STATE BRICK PLANT

Since installing a Riley "RO" Boiler coal costs have decreased 30% while making 10% more brick.

AT A CONNECTICUT TEXTILE FINISHING PLANT

Steam costs since installing Riley "RO" Boiler are 45% less than when steam was purchased from an adjoining plant.

AT A MINNESOTA DAIRY PRODUCTS PLANT

Riley "RO" Boiler cut steam cost 16% over low head boiler operation.

AT A SOUTHERN TEXTILE PLANT

Coal costs were reduced over 22% when a Riley "RO" Boiler was installed.

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COMPLETE STEAM GENERATING UNITS

It will pay you to visit modern Riley Installations

prove that it pays to install RILEY "RO" BOILERS

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Scoville Manufacturing Co. Waterville, Conn.
J. S. Abercrombie Co. . Sweeny, Texas
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Republic Creosoting Co. . Lima, Ohio
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Pet Milk Co. . . . . Delta, Ohio
Pet Milk Co. . . . . Weyland, Mich.
Pet Milk Co. . . . . Neosho, Mo.
Pratt, Read & Co. . . Ivoryton, Conn.
Ohio Wax Paper Co. . Columbus, Ohio
Elizabeth Magee Hospital Pittsburgh, Pa.
Master Tire & Rubber Co. Findlay, Ohio
Nunn Bush Shoe Co. . Milwaukee, Wis.
Lydia Cotton Mills . . Clinton, S. C.
Chemical Industries . Newark, N. J.
A. M. Collins Manufacturing Co. Philadelphia, Pa.
Denison University . . Granville, Ohio
Henry F. Ortlieb Brewery Philadelphia, Pa.
Putnam Finishing Co. Mechanicsville, Conn.
Waterbury Button Co. Waterbury, Conn.
N. Carolina State Capitol . Raleigh, N. C.
Lago Oil & Transport Co. Aruba, D.W.I.
Revere Copper & Brass Co. Baltimore, Md.
Chestnut Farms Dairy Washington, D. C.
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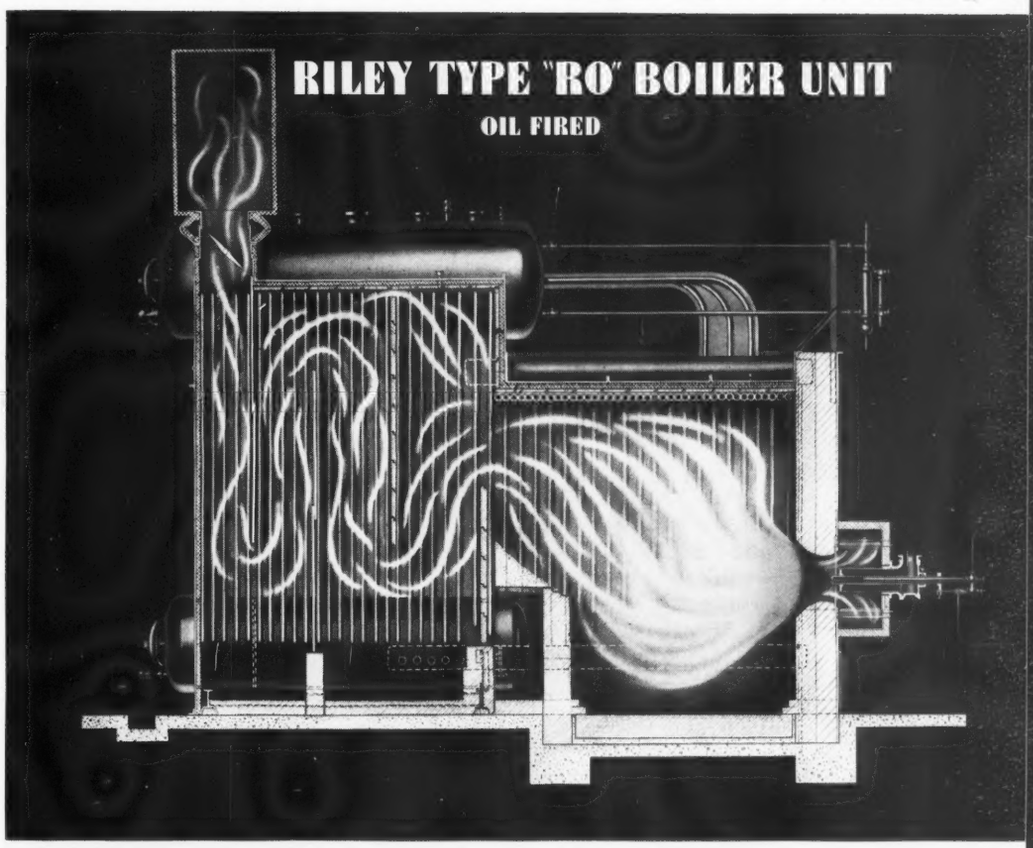
Rochester Dairy Co. . Rochester, Minn.
Seneca Knitting Co. Seneca Falls, N. Y.
Hercules Powder Co. . . Carthage, Mo.
Bastian Bros. . . . Rochester, N. Y.
Crescent Puritan Laundry Rochester, N. Y.
C. G. Conn Co. . . . . Elkhart, Ind.



For Capacities between 7500 and 40,000 lbs. per hour
THE RILEY TYPE "RO" STEAM GENERATING UNIT

Riley "RO" Boilers can be fired by Stokers, Oil, Gas or Pulverized Coal

RILEY "RO" BOILERS SAVE MONEY because of

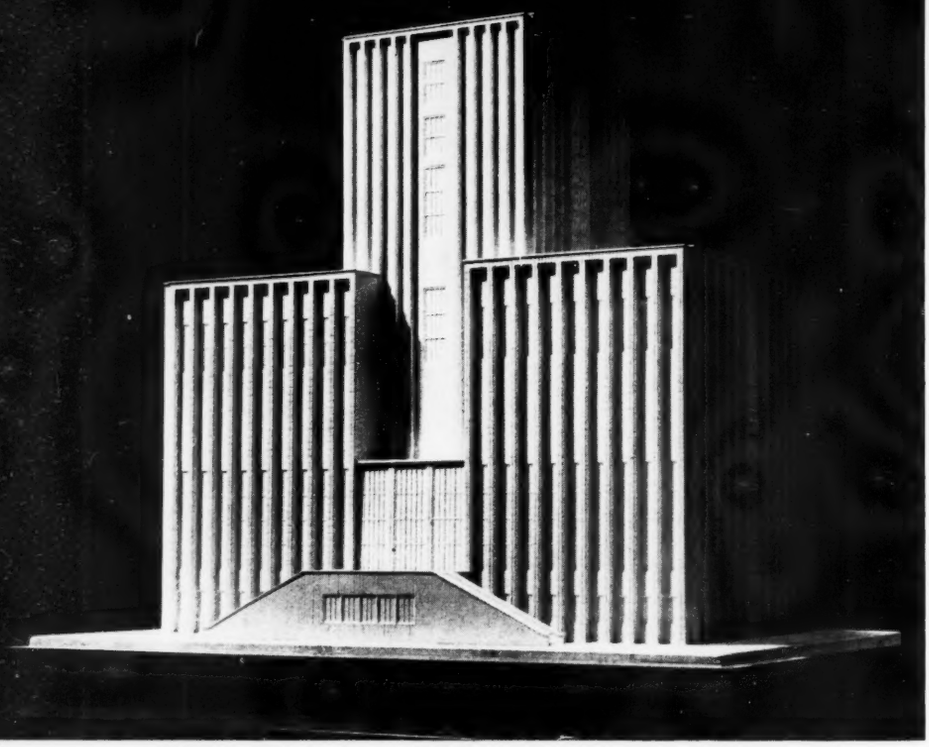
- higher possible combustion efficiency
- lower flue gas temperatures
- less radiation loss
- lower maintenance

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment



trostatic dust collectors, which have an efficiency of 98%. High ash content of fuel (may run up to 35%) means unusually large dust collectors. Induced-draft fans discharge into stub stacks, entirely concealed by the building structure.

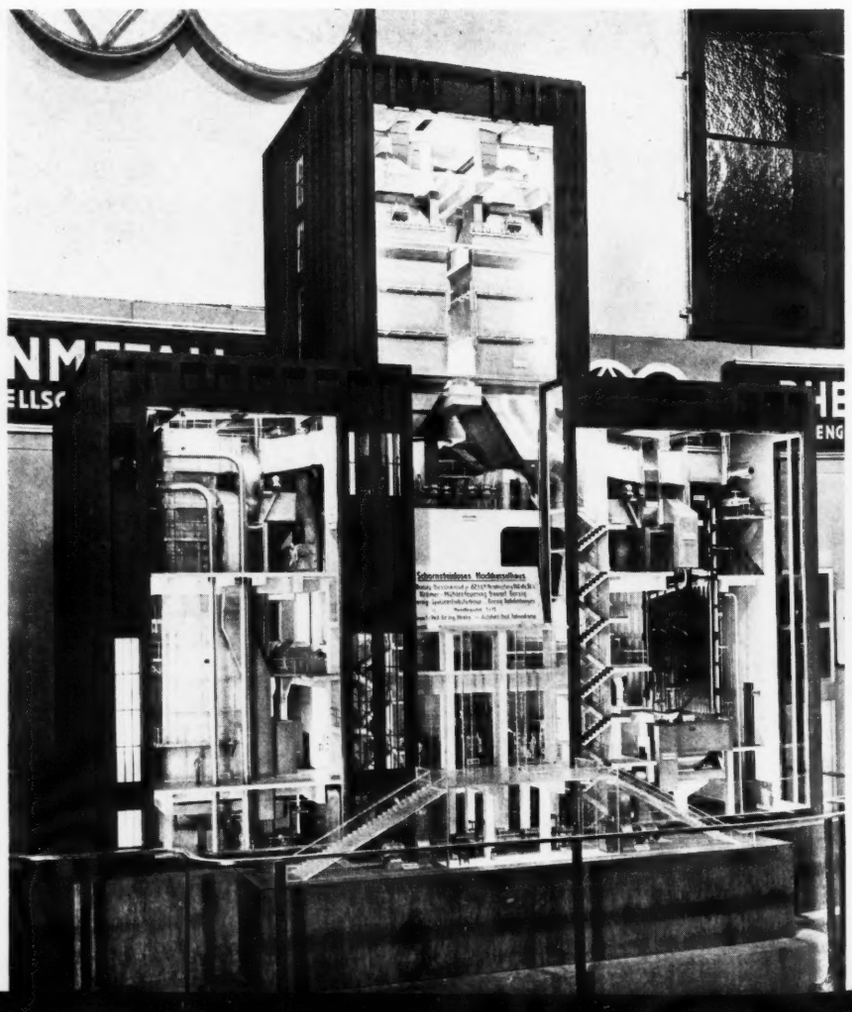
Control for the entire plant is centralized in a glass-cased, dustproof, air-conditioned room where the operators are protected from noise and heat.

"Park Avenue" Boiler Plant

OFTEN POWER PLANTS have to be set down in residential or high-class business sections. To avoid creating a nuisance, special steps must be taken to design an attractive exterior and the smoke and dust problem must be solved. The models show a standardized answer, developed by the German specialists, Fahrenkamp and Hencky, working with Rheinmetall Borsig AG and other firms. Several units of this type have been ordered.

Plants of this design will be basically similar, but will vary in size and in detail to meet local requirements. That shown has a steaming capacity of 500,000 lb per hr, equivalent to 65,000–70,000 kw. The four Benson single-flue boilers operate at 1950 lb and 935 F, burning a mixture of low-grade coals pulverized by Kraemer mills. Fuel, delivered to basement hoppers, is lifted to bunkers and finally fed to mills by band conveyors in dustproof casings. Two mills with a capacity of 4.5 to 5.5 tons per hr, each, serve each boiler. Ljungstrom air heaters raise 85% of combustion air to 690 F.

Boiler waste gas passes through elec-



THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

Broadmoor Knows the Cost of Power

Mr Monaghan, recent chief engineer of Colorado Springs' Broadmoor Hotel, shows how power services are distributed and the costs. This knowledge means money saved

By J J MONAGHAN*

WE CALL the Broadmoor a hotel, though it's more like a miniature mountain empire. The hotel proper (a 7-story building with five adjoining buildings and wings) is merely the focal point of a vast aggregation of recreational facilities. This central group accommodates 800 guests in the ultimate of resort luxury. Elevation is 6300 feet. The real Rockies rise a mere mile away, across the artificial lake that incidentally furnishes the power plant with its condensing water. Above looms cloud-capped Pikes Peak, 14,109 ft.

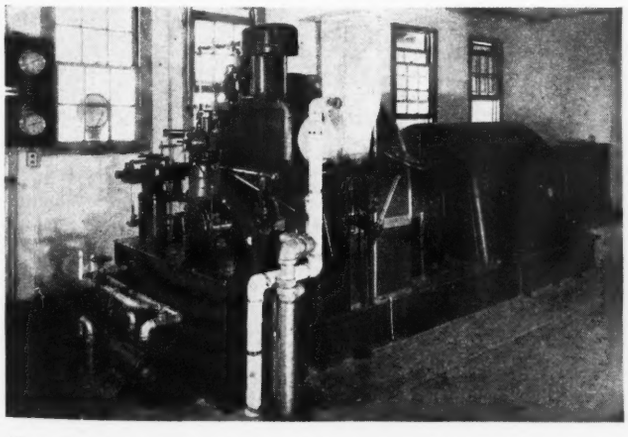
The big indoor swimming pool is in the main hotel group. Close by the hotel, but out of sight, is the power plant, supplying light, power, heat and refrigeration to all Broadmoor units within economical transmission distance. Beyond its reach are the great granite tower of the Will Rogers Shrine of the Sun, two miles up Cheyenne Mountain, and the Cheyenne Mountain Lodge. These two get their electricity from the Colorado Springs Municipal distributing system, and heat, where needed, from plants on the spot. Nearer Broadmoor, units served by the hotel plant include the golf club, the Will Rogers Stadium, the great Ice Palace (an indoor, year-round rink in which 700 can skate while 1400 watch), laundry, dry-cleaning department, greenhouses, garages, saddle stables and the largest private zoo in the West.

The load curves of such a combination are necessarily very different from those of a typical city hotel, particularly because of seasonal trade variations, the cool mountain climate and the special demands of the ice palace and the swimming pool.

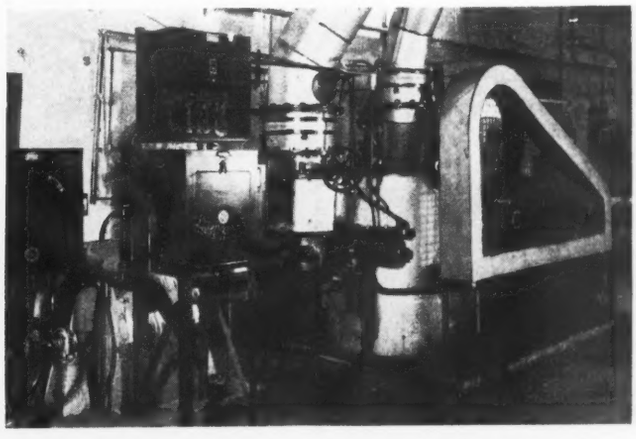
Power is stepped up from 480 volts to 2300 volts for transmission to the Ice Palace, and then back to 480 volts to operate the motors driving two 35-ton and one 15-ton ammonia compressors. Brine pumped through 11 miles of pipe in the rink floor freezes the ice. And the ice-cooled room must be rewarmed for spectator comfort. All Broadmoor units are heated by hot water. Nature provides the air conditioning. Hot-water radiator surface aggregates 144,700 sq ft.

In recent years, the Broadmoor power plant has been modernized step by step to permit steam generation with the

* Mr Monaghan is now Chief of the Children's Hospital, Denver, Col.



New 500-kw condensing turbine normally supplies entire electrical and heating load. Steam for service hot water and building-heating water is heated by bled steam



Provided with steam-preheated air at 274 F, mill pulverizes 11,000-Btu semi-bituminous coal for the new 26,000-lb-per-hr steam-generating unit

cheapest fuel and at the highest possible boiler efficiency, and to produce the electrical load, as far as possible, as a byproduct of the heating load. A cost and record system has been established to reveal any dollar wastes in generation, distribution or consumption, and permit their correction.

The power house now contains two modern steam-generating units—a 25,000-lb-per-hr gas-fired boiler installed in 1935 (POWER, Oct, 1935) and a 26,000-lb-per-hr water-walled boiler equipped to burn pulverized coal, natural gas or oil. This last boiler was installed in 1938 and described in POWER, Jan, 1939.

Both boilers supply steam at 150 lb g and 450 F. They are equipped with automatic combustion control and meters for efficient operation. Over-all boiler and furnace efficiency averages 79% for the gas-fired boiler and 83% for the coal-fired. This last figure does not allow for the power used by the 40-hp pulverizer motor or for the live steam used to preheat primary air to pulverizer to 274 F (for coal drying). To a large extent, the apparent high efficiency obtained with coal merely reflects the recirculation of boiler heat output back through the furnace via this preheated air.

The Records

Attached are some service records for February, 1939, an off-season month for the hotel proper. The primary fuel is a 11,000-Btu semi-bituminous coal mined 50 miles from the plant. Lignite can be obtained from a nearer point but is a less economical fuel here, requiring 1.25 tons to equal one ton of the semi-bituminous.

Analysis of coal and gas costs shows that it would be most economical to burn the semi-bituminous exclusively if the existing gas contract did not compel the plant to pay for $500 worth of gas each month. This amount, approximately, is used each month (in the 1935 boiler) leaving the bulk of the steam to be generated by coal.

Roughly, the monthly gas consumption amounts to 3,000,000 cu ft at $516, or 17.2¢ per 1000 cu ft. At this rate, and assuming no fixed charge for gas, the monthly fuel cost for generating all steam by coal would be $540 less than if gas were used exclusively.

Cost of the 11,000-Btu coal delivered to the Broadmoor bunkers (including ash removal) is $2.80 per ton.

The main electrical load is now generated by a 500-kw bleeder condensing turbine, with two older 200-kw geared non-condensing turbines as standby. Circulating water for the condenser is obtained without cost (except pumping) from the artificial lake at the hotel. To protect the lower stages of the turbine, not less than 10% of the throttle steam passes to condenser at all times.

Steam bled at 6 lb, approximately, supplies the water heaters for building heat and service water, also the deaerating heater. When necessary, this same main can be supplied by the exhaust of two 200-kw non-condensing turbines.

Separate heaters are, of course, used for service water and building heating water. Service-water requirements average 3000 gal per hr at 165 F. Temperature of the building-heating water varies with the season. At times, when the power load is not enough to supply the heating load, a live steam heater boosts the temperature of water leaving the low-pressure heaters.

Table I shows cost of steam and electricity. Steam costs include all elements except interest and depreciation; insurance is included as an operating charge. Although the newest boiler is equipped to burn pulverized coal, gas and oil, two fuels are never burned simultaneously. Normally, all coal is burned in the new boiler and all gas in the 1935 boiler. Thus, the engineer knows the amounts of steam generated by each fuel. Normally, all electricity is generated by the bleeder-condensing turbine.

TABLE I—COST OF STEAM AND ELECTRICITY

(February, 1939)

Steam

Coal	$1476.52	Oil-Waste-Packing	26.64
Gas	620.09	Household stores	5.11
Wages	635.00	Insurance	7.13
Repairs	54.61	Miscellaneous	52.07
Water	114.65		
		Tot. cost	$2991.82

M lb steam generated by coal only	8,052.6	
M lb steam generated by gas only	2,170.8	
Total steam generated	10,223.4	
Tons of coal burned	527.3	
M cu ft gas burned	3,800.7	
Fuel cost per 1000 lb of steam generated by coal only		18.33¢
Fuel cost per 1000 lb of steam generated by gas only		28.59¢
Average fuel cost of all steam generated		20.51¢
Wages		6.21¢
Other		2.54¢
Total operating cost to generate 1000 lb steam		29.26¢

Electricity

Kwhr generated	161,475
Steam for electricity (from mfg. curves)	3,310,000 lb
Lb steam per kwhr	20.5
Steam cost of electricity, per kwhr	0.60¢

TABLE II—DISTRIBUTION OF STEAM AND ELECTRICITY

(February, 1939)

Electricity	Kwhr	Dollars
Ice palace	34,233	$205.50
Power-plant auxiliaries	47,797	286.93
Garage	9,527	57.19
Refrigeration (except ice palace)	23,252	139.59
Laundry	2,745	16.48
Kitchen	4,360	26.17
Hotel	39,561	237.49
Total	161,475	$969.35

Steam		
HIGH PRESSURE	M lb	Dollars
Kitchen (metered)	683.5	$200.44
Laundry (metered)	381.4	110.70
Feed pump (Estimated)	672.0	197.46
Electricity (See text)	3,310.0	969.35
Preheat pulverizer air	1,075.2	317.13
LOW PRESSURE		
Hotel	2,457.8	718.05
Garage	616.7	179.51
Greenhouse	410.1	119.67
Ice palace	616.7	179.51
Total steam (h-p and l-p)	10,223.4	$2,991.82

How to Withdraw Ammonia from a System

WITHDRAWING AMMONIA from a refrigerating system looks like a simple chore. It really is, but like many simple jobs, there's a whale of a difference between doing it right and doing it wrong.

At every stage of the game, take care that the cylinder doesn't get overfilled—that spells trouble. If an overfilled cylinder gets heated slightly, there's no room for the ammonia to expand and something's got to go. Because of this hazard, the ICC is tough on shippers handling overfilled cylinders—they get a heavy fine and penalty.

Start by weighing the cylinder, with the cap off. Check this weight with the manufacturer's tare weight (on the cylinder tag) to see if the cylinder is empty. If your weight is higher, there's ammonia in the cylinder already, which is just that much less to be added.

The drawings show two hookups for withdrawing ammonia. They illustrate two types of cylinders; one is filled in a horizontal position, the other vertical. However, chief difference in the hookups lies in the provision for purging or lowering cylinder pressure. How this affects the filling operation will be explained later. Either hookup can be used with either cylinder type. When filling a horizontal cylinder, inside dipper pipe should point up.

When pipe connections have been made, using extra-heavy steel pipe, flexible steel tubing, or high-pressure armored rubber hose, place the cylinder on the scale platform and weigh again. Record this weight as the starting point from which to gage the filling.

Starting the Flow

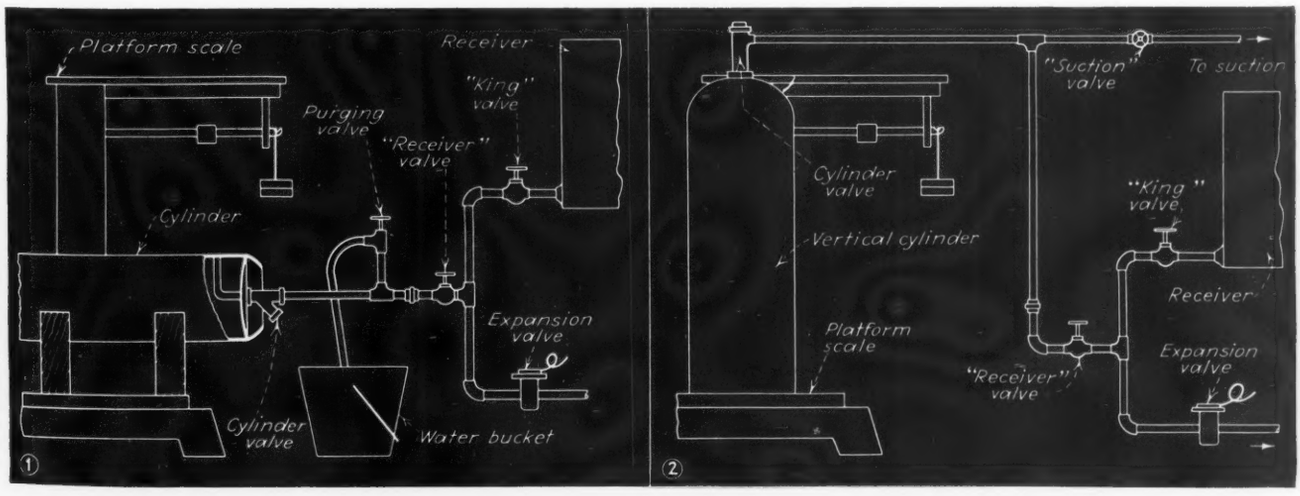
When everything is set, close the expansion valve and run the compressor slowly, keeping a full head of water on the condenser. Ammonia is thus pumped into the condenser and liquid collects in the receiver. Watch the receiver gage glass to avoid overfilling. As soon as some liquid shows in the glass, open the cylinder valve and the receiver valve. Be sure the purging valve (1) or the suction valve (2) is closed. As ammonia enters the cylinder, watch the scale beam to check rate of filling.

After a time, flow will slow down, due to pressure building up in the cylinder. If using Hookup 1, close the receiver valve and open the purging valve. This permits non-condensible gas to flow from the cylinder into the water, which will absorb ammonia gas coming with it. As long as bubbles show, non-condensible gas is present. When bubbling stops, close purging valve, open receiver valve and proceed with the filling.

If connected as in Hookup 2, close the receiver valve and open the valve in the line leading to the suction. This will lower cylinder pressure. After half-a-minute or so, close the suction valve and open the receiver valve. This operation, or that described in the preceding paragraph, should be repeated as often as needed to fill the cylinder.

When the scale beam shows that the right amount of ammonia has been added, making allowance for any ammonia that might have been in the cylinder at the start, close receiver and cylinder valves and disconnect cylinder. For a final check, weigh the cylinder alone, with the cap off. Subtract from this weight the *manufacturer's tare weight*. The difference is the amount of ammonia in the cylinder. If this exceeds the allowed amount, discharge some of the ammonia. This may be done in a well-ventilated space if only a small quantity is involved, but the best plan is to discharge into water, which will absorb the ammonia.

Data for this article was furnished by National Ammonia Div, E I du Pont de Nemours Co; Henry Bower Chemical Mfg Co; Pennsylvania Salt Manufacturing Company.



Two hookups for withdrawing ammonia from a refrigerating system

COMBUSTION
Made Easy

By BILL MADDOCK
Tucson Gas, Electric Light and Power Co

MANY TIMES an operating engineer has to calculate flue-gas volumes, weights and velocities to help determine duct or fan size as well as combustion performance. Unless the formulas and charts are all kept together it is easy to get lost in a maze of figures and papers.

Tables below gives complete data on most fuel components. The idea is to figure each component of the fuel as though it were being burned separately. Then the lb of air required to burn the fuel is the sum of the amounts necessary to burn each part.

Split up the calculation by starting with the fuel analysis. Whoever sells you the fuel will be glad to furnish this. Then decide to stick to a volume basis or a weight basis, follow through the table for, say, air required for combustion, to find out how much would be needed for one lb or one cu ft. Then multiply by the percentage of that component occurring in the fuel.

After doing this for all components, add them up and you have your answer

FUEL					REQUIREMENTS OF COMBUSTION							
CHARACTERISTICS					*Cubic Feet per Cubic Foot*		*Pounds per Cubic Foot*		*Cubic Feet per Pound*		*Pounds per Pound*	
Name	*Symbol*	*Molecular Weight*	*Per Cent Carbon*	*Cubic Feet per Pound*	*Oxygen*	*Air*	*Oxygen*	*Air*	*Oxygen*	*Air*	*Oxygen*	*Air*
Hydrogen	H_2	22	0	189.5	0.5	2.39	.012	.182	96	453	8	34.56
C to CO	C	12	100	14.97	0.5	2.39	.083	.382	16	75.5	1.3	5.74
C to CO_2	C	12	100	14.97	1.0	4.78	.178	.764	32	151	2.7	11.48
CO to CO_2	CO	28	43	12.81	.5	2.39	.012	.183	6.8	32.4	.57	2.47
Sulphur	S	32	0	.....	.....	.....	.....	.....	12	57.0	1.0	4.35
Methane	CH_4	16	75.0	23.69	2.0	9.57	.169	.73	48	227	4.0	17.2
Acetylene	C_2H_2	26	92.0	14.58	2.5	11.96	.21	.91	37	174	3.1	13.3
Ethylene	C_2H_4	28	86.0	13.54	3.0	14.35	.25	1.09	41	194	3.4	14.8
Ethane	C_2H_6	30	80.0	12.64	3.5	16.73	.293	1.27	45	211	3.7	16.1
Gasoline	C_8H_{18}	114	84.0	3.33	12.5	59.81	1.04	4.52	42	199	3.5	15.11
Natural Gas		18.4	74.0	21.4	2.10	10.1	.178	.775	46	215	3.8	16.5

PRODUCTS OF COMBUSTION																		
Name	*Cubic Feet per Cubic Foot*			*Pounds per Cubic Foot*				*Cubic Feet per Pound*				*Pounds per Pound*				*Orsat Reading*		*Btu per Pound*
	Carbon Dioxide	*Water*	*Nitrogen*	*Carbon Dioxide*	*Water*	*Nitrogen*	*Total*	*Carbon Dioxide*	*Water*	*Nitrogen*	*Total*	*Carbon Dioxide*	*Water*	*Nitrogen*	*Total*	*Carbon Dioxide*	*Nitrogen*	
Hydrogen	.....	1.00	1.89	.....	.018	.110	.1876	.....	189	356	519	.....	9.0	26.56	35.56	.....	100	62,000
C to CO	1.00	.....	1.89	.074	.....	.139	.2125	31.6	.....	60	91.6	2.3	.....	4.41	6.74	36.4	63.6	4,380
C to CO_2	1.00	.....	3.78	.114	.....	.279	.3930	31.6	.....	120	151	3.67	.....	8.81	12.48	20.9	79.1	14,540
CO to CO_2	1.00	.....	1.89	.116	.....	.139	.255	13.5	.....	25.8	39.3	1.57	.....	1.90	3.47	34.5	65.5	4,330
Sulphur	.....	.....	.....	.....	.....	.....	.....	SO_2 11.6	.....	15.2	56	SO_2 2.0	.....	3.32	5.35	SO_2 20.4	79 6	4,050
Methane	1.00	2:00	7.56	.118	.095	.560	.773	23.7	47.4	178	250	2.75	2.25	13.23	18.23	11.7	88.3	23,850
Acetylene	2.00	1.00	9.45	.232	.048	.70	.98	29.2	14.6	138	182	3.38	.69	10.2	14.25	17.5	82.5	21,460
Ethylene	2.00	2.00	11.34	.233	.096	.838	1.167	27	27	153	207	3.14	1.3	11.34	15.77	15	85	21,150
Ethane	2.00	3.00	13.23	.232	.142	.970	1.344	25.3	37.9	168	231	2.93	1.8	12.35	17.08	13.1	86.9	22,230
Gasoline	8.00	9.00	47.25	.927	.425	3.48	4.732	26.6	29.8	157	214	3.09	1.4	11.60	16.11	14.5	85.5	20,542
Natural Gas	1.10	2.05	8.0	.126	.098	.590	.814	23.2	43.5	170	237	2.72	2.1	12.60	17.39	12.1	87.9	22,600

ASSUMED CONDITIONS

Air —13.1 cu ft per pound
4.35 x Oxygen by weight
4.76 x Oxygen by volume

N_2 —13.6 cu ft per pound
3.33 x Oxygen by weight
3.76 x Oxygen by volume

CO_2—8.6 cu ft per pound
1.53 x Air by weight

O_2 —11.8 x cu ft per pound

All at 60 F; 14.7 lb abs

without sitting up nights with a chemistry book or trying to worry about what is a gram-molecular weight. You have done the same thing the high-priced experts do but the table took the hurdles.

For example, if a good grade of Eastern coal analyzes as follows:

Carbon	81.5%
Hydrogen	4.5%
Oxygen	4.0%
Nitrogen	1.2%
Sulphur	1.3%
Ash	7.5%

and you want to find the lb of gas and its volume produced per lb of coal burned, we can set up a calculation to get both answers quickly.

The first step is to calculate how much of the hydrogen in the coal is actually available as fuel. Any hydrogen that is already combined with oxygen, obviously can not burn. It takes 8 parts of oxygen by weight to combine with one part of hydrogen, so we subtract the oxygen percentage, 4.0%, divided by 8 (4.0% ÷ 8 = 0.5%) from the hydrogen content 4.5% (see analysis), to get the hydrogen available for combustion. (4.5% — 0.5% = 4.0%).

Then set up a calculation like this, taking the values directly from the proper column of the table, and multiplying by the per cent of fuel component in the coal:

Fuel	Lb fuel in lb coal		Lb gas per lb fuel		Lb gas per lb coal
Carbon	0.815	×	12.48	=	10.2
Hydrogen	0.040	×	35.56	=	1.4
Sulphur	0.013	×	5.35	=	0.1
Total					11.7

Now to find the volume, your calculation is just the same, except that values are taken from the "Products of Combustion" table for the total cu ft per lb:

Fuel	Lb fuel in lb coal		Cu ft gas per lb fuel		Cu ft gas per lb coal
Carbon	0.815	×	151	=	123
Hydrogen	0.040	×	549	=	22
Sulphur	0.013	×	56	=	1
Total					146

These values are for perfect combustion with no excess air and the gas volume is not corrected for flue-gas temperature. This latter correction is made by using the absolute temperatures (add 460 to deg F) as follows:

Gas volume at 600 F = Gas volume at

$$60\text{ F} \times \frac{460 + 600}{460 + 60}$$

or $$146 \times \frac{1060}{520} = 276 \text{ cu ft}$$

To calculate the gas quantities for combustion with excess air, say 20%, the air quantities per lb of coal must be calculated first in addition to the gas quantities. Then 20% of the air quantities can be assumed to pass through the combustion zone without being affected, that is, add extra lb of air directly to lb of gas, or extra cu ft of air to cu ft of gas, before correcting for temperature.

✦ ✦ ✦

Model Maintenance Schedule

Golden rule of all engineers who believe an ounce of prevention is worth a pound of cure: "Follow a planned maintenance program." Here's the schedule laid out for the Mechanical Dept of Geo E Keith Co (Walk-Over Shoes), Campello, Brockton, Mass. It won't fit your plant exactly, but it may give you an idea

EVERY DAY

1. Inspect all low-pressure, high-pressure and return piping in buildings and tunnels. Any leak or trouble must be attended to at once.

2. Inspect and adjust boiler and pump-room setups, including oil-burning system.

ONCE A MONTH

3. Repair or adjust all leaky ball cocks, faucets, bubblers, water coolers and water valves in all toilet rooms.

4. Check cold-water pump in No. 11.

5. Go over all sprinkler systems with their valves and controls, wet and dry, and see that all valves are set correctly. A D T inspects entire sprinkler system the first of each month.

6. Inspect street mains, hydrants, fire pump, fire pails, stair doors and the 100,000-gal. reservoir.

7. Service and oil all elevator machinery. Otis man also inspects first of month and reports.

TWICE A YEAR

8. Between runs, check all line shafting, oil and grease bearings; inspect and dress all belting; check and oil all mullers and dryers; oil, test and clean all sump pumps, No. 11 and subways.

9. Check and oil boiler-room coal conveyor.

10. Inspect and grease, or oil, all blowers and their motors.

11. Clean out base of boiler-room stack and boiler-outlet breechings.

12. Check and change oil in air-compressor pumps.

13. Check No. 11 cutting-room conveyor and No. 3 Lamson dryers.

14. Clean and service all motors and controls.

15. Check all main fuses and feeder connections in all buildings.

16. Clean out back of switchboards.

17. Inspect main transformers.

18. Go over time clocks, batteries and telephone service.

19. Have carpenters inspect all windows, glazing, doors, locks, stairs and floors.

ONCE A YEAR

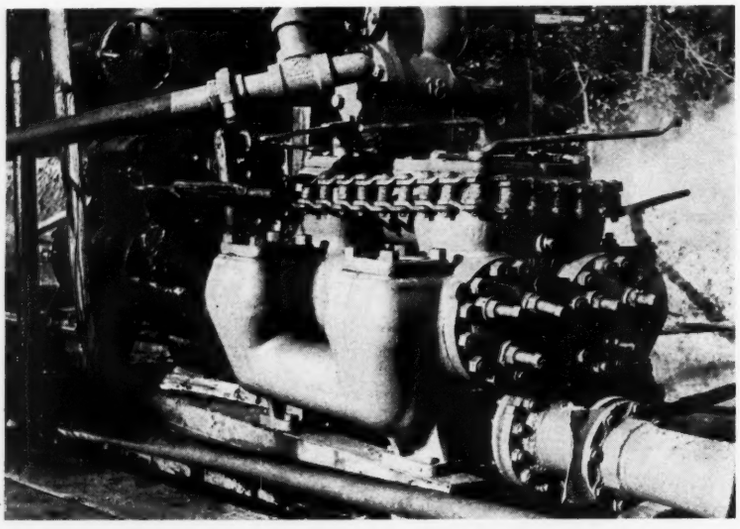
20. At beginning of heating system, check (1) high-pressure traps, (2) vacuum system on steam heating, (3) flow of steam on all radiators, coil banks and traps, (4) thermostatic heating system in No. 11 and have service company go over it, (5) high-pressure reducing valves.

21. Inspect and clean out all hot-water tanks.

22. Clean out and paint tanks in No. 11 water cooler.

23. Paint and touch up all mullers and dryers.

PRACTICAL AIDS TO OPERATION



Chain Reinforces Old Pump Frame

A SHORT SECTION OF HEAVY DRILLING CHAIN, fitted with appropriate hooks and turnbuckle, ties together the steam chest and valve body of an old slush pump, as in the photo. This relieves the pump casting of much of the stress that frequently broke the tie section when the pump was suddenly overloaded.

The chain and turnbuckle come above the pump rods, and do not interfere with repacking or other servicing operations. Being where it is easily worked on, the chain can be adjusted at any time when there is the least indication of reduced tension.

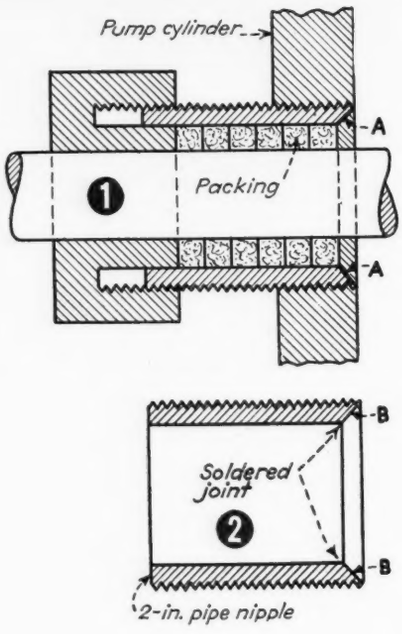
Longview, Texas M T PATE

Pipe Nipple Repairs Broken Stuffing Box

ONE OF OUR PUMPS has a brass stuffing box that screws into the cylinder casting, see Fig. 1. One night the watch engineer pulled the packing so tight that he cracked the bottom out of the box at *A*. Next morning when the stuffing box had been taken out I found that it was the same size as a 2-in. brass-pipe nipple. I decided that a repair could be made, because the bottom of the box remained as a ring.

To make the repair I shaped the edge of the ring and the end of the nipple as at *B*, Fig. 2. Then, set the ring slightly inside the end of the nipple and peened the end of the nipple over onto the ring to hold it in place. I thoroughly soldered the joint to complete the job.

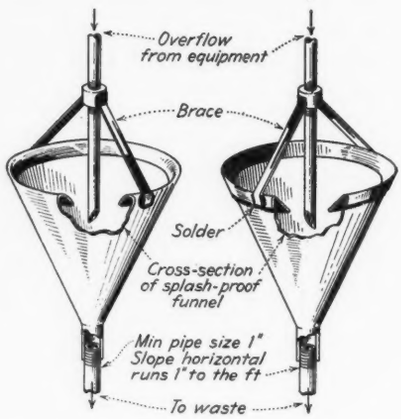
Riverdale, N. Y. ALEX GRAY



Splash-Proof Funnels

UNSIGHTLY PUDDLES OF WATER on floor areas around machinery seriously detract from appearance of well-kept power plants. These accumulations are most frequently caused by equipment or piping leakage, a condition that can be avoided by proper attention to maintenance. Poorly layed out visible overflow drainage systems for bearing cooling and other waste water, however, are often the offenders.

Splash-proof funnels, Fig. 1, can be purchased. When these are not readily available, a turned-in sheet-copper rim may be soldered onto an ordinary funnel, Fig. 2, as we did in our plant. In addition, we beveled the end of the pipe as shown to obtain smooth flow. We



also fastened the pipe so that its end is below the turned-in rim of the funnel. Always provide a pipe of ample size to carry water away from the funnel and see that it is kept clean.

Lynchburg, Va. C R ROBERTS

Bearing Telephones When in Trouble

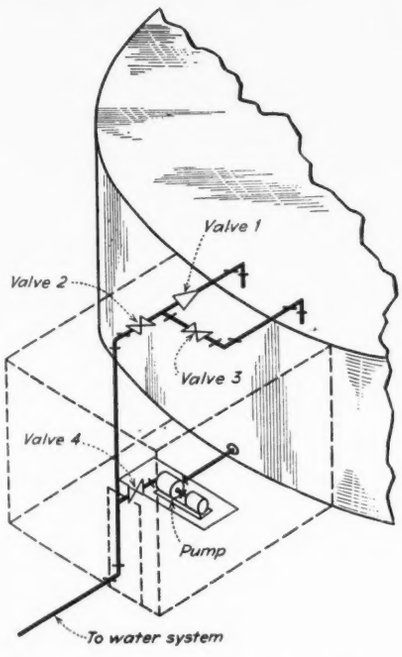
ABOUT 2 YEARS AGO we installed a loud-speaking phone system on the elevators in the 70-story building at 40 Wall St. New York, N. Y. This has 5 master phones in a central location where a man is always in attendance and 20 remote phones in the motor rooms and

dispatcher's cabinet in each corridor on the ground floor. These phones (see photo) keep us in close touch with every point of maintenance on the elevator system and also with the dispatcher.

The attendant becomes familiar with regular noises coming in over the master phones and can identify any unusual sounds. In this way he has detected impending trouble as far as several hundred feet away. One day an unusual noise came in from one of the motor rooms. A mechanic was sent immediately to this room and found a secondary-sheave bearing running hot and making a noise. By this quick action the trouble was corrected before the bearing burned out and shut down the elevator.

New York, N. Y. WILLIAM DEVAUGHN

Relief Valve Prevents Spilling Overhead Tanks



WE RECENTLY EXPERIENCED TROUBLE with overhead tanks spilling over on our water system. Pumping could not be controlled conveniently, because base pumping was from a mine in which the water had to be kept at a low level. The problem was then to get rid of excess water, which was done by installing a relief valve at a 3,000,000-gal. emergency storage reservoir that is part of the distribution system (see figure). This tank is normally filled through valves 2 and 3 and is pumped back into the system through valve 4 if the main supply fails.

We set the relief valve to open at a pressure slightly below that which will cause the overhead tanks to spill. Then with valve 2 open and 3 closed, any excess water spills into the emergency reservoir. We try to keep about 25% of the capacity of this reservoir available to take overflow from the system. The relief valve has worked satisfactorily and has prevented overflow of the overhead tanks. In winter, overflow from these tanks used to freeze and cause a serious ice hazard.

Hibbing, Minn. A L BENNETT

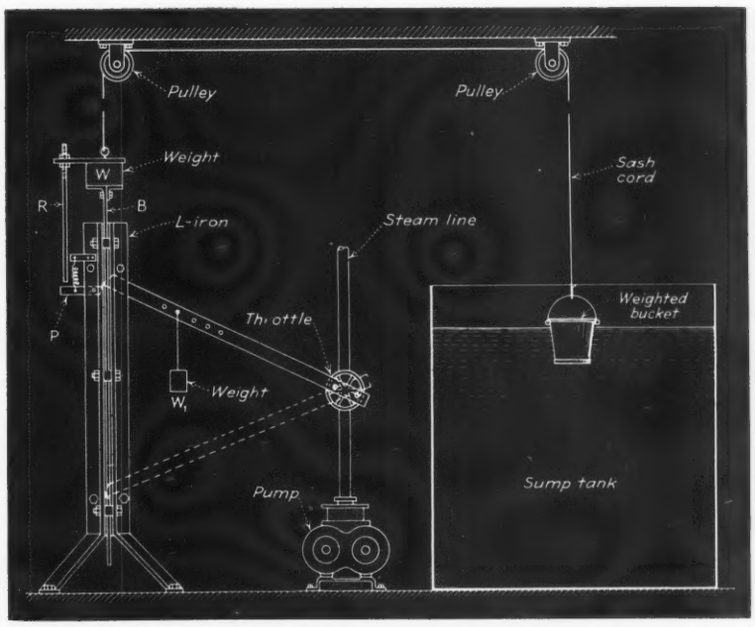
Automatic Control for Steam Sump Pump

WHEN THE MONEY IS AVAILABLE, buy automatic control; when it is not, then your resourcefulness and odds and ends must supply your needs. In our plant, the waste-water sump and its steam pump are about 40 ft below the engine-room floor. The pump was started and stopped manually, which required a lot of climbing up and down a ladder. To save ourselves all this work we built the automatic control shown in the figure.

With four pieces of small 1-in. angle iron we made a stand separating the angles by short sections of pipe on the holding bolts. To operate the steam valve, we cut a slot about $\frac{3}{8}$ in. wide and 3.5 ft long in a piece 1x$\frac{1}{8}$-in. iron 5 ft long to move up and down inside the angles. On the top of the slotted bar we connected a weight W and a trip rod R. An operating level of $\frac{1}{4}$x1-in. iron was connected at one end to the steam valve and the other end put through the slot of the weighted bar in the stand. For a float we used a weighted bucket and connected it by a rope through pulleys to the top of weight W.

Now, as the pump empties the sump, the weighted bucket goes down and raises the slotted bar and with it the arm on the throttle valve. When this arm is lifted to the position shown, the throttle valve is closed and pawl P drops under it to keep it from going down with the slotted bar as the float rises with the filling of the sump. When the sump fills again, tripping rod R comes down on pawl P and releases the throttle-valve arm, which falls to the bottom of the slot in bar B to start the pump. Of course, weights on the float and W and W_1 must be adjusted to obtain correct operation.

Liverpool, N. Y. R A WELLS



Human Trickery Causes Trouble

ELECTRICAL TROUBLES are sometimes caused by human trickery, the case on a 550-volt rotary converter. I was called in

to determine why the night operator had trouble synchronizing the machine when putting it into service. Arriving on the job, I discovered that relations between the day and night operators were not as pleasant as they might be, with the day operator apparently the aggressor.

Synchronizing was done with lamps connected to be dark at synchronism. Lamp sockets were burned out when the night operator was synchronizing and the machine had been connected to the transformers badly out of phase.

By a little detective work I found that the day operator had loosened one of the synchronizing lamps in its socket. Then, when the night operator tried to synchronize, the high peak voltage when the machine was 180 deg out of phase would cause an arc in this socket and give a wrong indication of synchronism. When confronted with the proof, the day operator admitted his guilt.

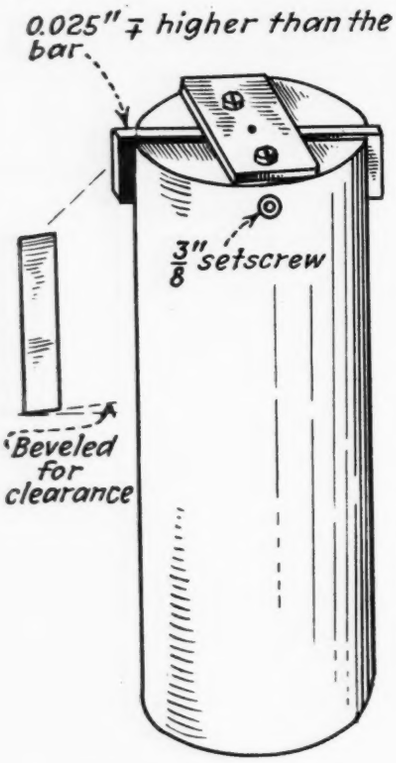
P. S.—He lost his job.

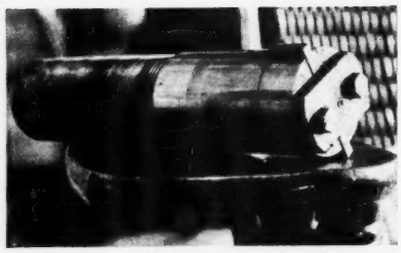
Plainfield, N. J. H W HODGSON

Cutting Bar for Governor Repair

WHEN ONE OF OUR ENGINE GOVERNORS gave trouble, we needed a boring bar to counterbore the hole in the flywheel spoke for the pin that supports the inertia bar. This we made from a section of 2.5-in. piston rod that would just fit the hole, as shown in the photo and drawing.

The cutting tool we made from a tool-steel blank such as used in making





wood-molding cutters. The cap on the end of the bar holds the tool in place and was also used to turn it with. A hole was drilled and tapped for a ⅜-in. set screw on one side of the bar, as in the diagram below, in order to hold the tool centered.

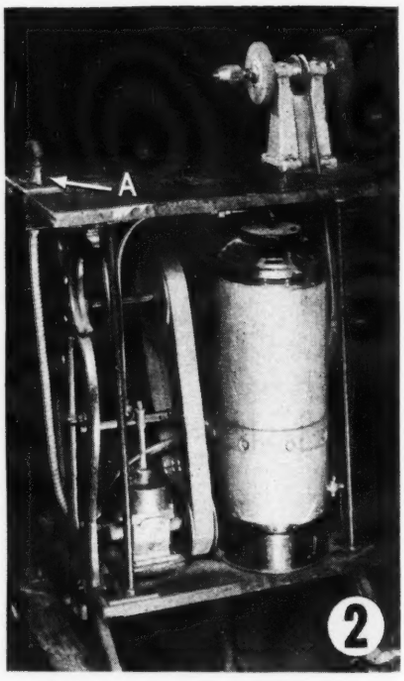
After annealing, we placed the cutter in the bar, centered the assembly in lathe, trimmed the cutter to the correct length and squared it with the bar. After this operation, we removed the cutter and ground each of its ends for clearance behind the cutting edge. We then tempered the tool and again secured it in place, after which we were ready to go to work. The bar fitted the hole snugly enough so that the boring job was done with a surprising degree of accuracy. A ratchet drill placed between the crank disk and the center mark on the cap of the bar maintained the required pressure, while the bar was turned with a wrench on the cap.

Hanover, N. H. A L WATERMAN

Oh Junk, What Are Thy Possibilities?

MANY ARE THE USEFUL TOOLS that can be produced from the scrap heap. The most useful tool in our plant is this kind of a product, but several junk piles made contributions. In one I found a large sewing-machine stand, on the drive shaft of which were a flat pulley, a flywheel, and a double-grooved pulley for two round belts. Near the bottom of this stand we mounted a platform along with a motor from a large portable vacuum cleaner, and belted the latter to the grooved pulley, see Fig. 1.

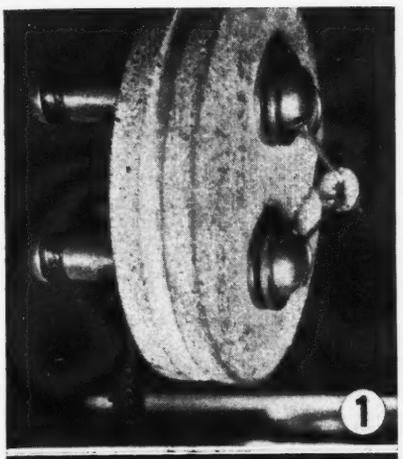
An old Franklin car contributed a tire-pressuring air compressor and we converted an old soda-acid fire extinguisher into an air receiver. These we also mounted on the platform with the motor and belted the compressor to the flat pulley, see Fig. 2. We bored and tapped the center of the extinguisher's filling cap for connection to the compressor and removed the hose and nozzle to provide for a compressed-air-line connection. The motor was wired to an attachment plug outlet and switch at *A* in the top platform and the whole unit mounted on 4 casters so that it could

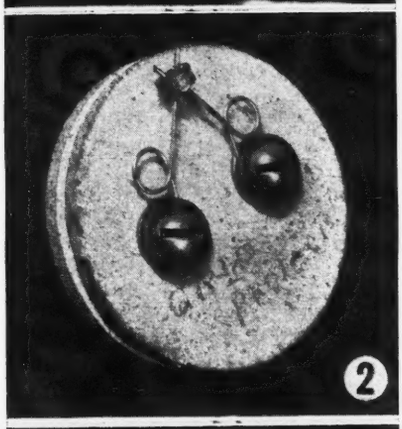


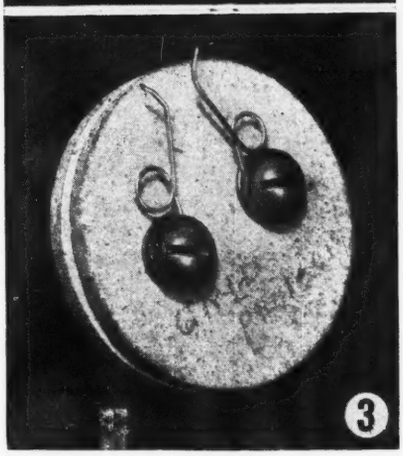
be easily taken anywhere in the plant where compressed air would be needed for maintenance or service.

There still remained one groove in the pulley that was not working so something had to be done about that. From another junk heap we obtained a small stand that supported a shaft in two bearings, each end of the shaft having a threaded extension. This we mounted on the top platform and belted it to the remaining groove. On one end of the shaft we placed a buffing wheel, on the other a grinding wheel. When

Grid Protector Stops Starter Burnouts







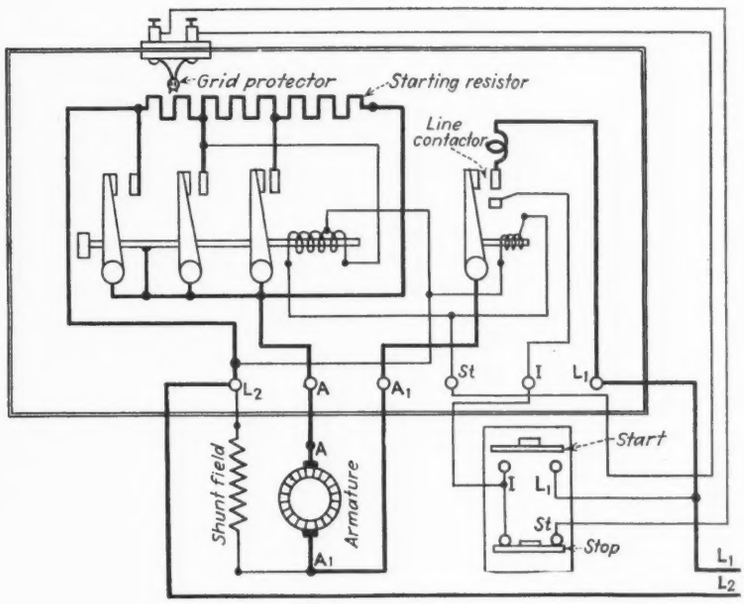
AN AUTOMATIC STARTER on some of our dc motors occasionally failed to cut out all the starting resistance, and before the trouble was discovered, the resistor burned out. To avoid this we devised the gadget shown in the photos and christened it "Grid Protector." This device comprises two steel spring-wire contacts held under the screw of two binding posts mounted on a piece of fiber, Fig. 1. Ends of the springs are held in a fusible link made of solder that melts at 158 F, Fig. 2.

This grid protector connects in the starting circuit and is placed so that the fusible link is near the grid resistor in the last section to be cut out of circuit, as in the diagram. When the start button is closed, current flows from the line L_1 through the start and stop buttons and through the contacts and fusible link of the grid protector, then through line-contactor coil to the L_2 side of the line. Now, if all the starting resistance is not cut out of circuit, high temperature melts the fusible link, the contacts part, Fig. 3, and open the starting-button-circuit to cut power out of the motor.

Results: Not a single resistor burnout since protectors were installed over 2 years ago. Protectors are made from material found in the what-not drawer, and cost practically nothing; while starters cost from $34 to $700 and may cause a 2-hour shut down for replacement.

Philadelphia, Pa.

G HERMAN DOST
Chief Electrician
Pennsylvania Sugar Co



the grinding wheel was tightened into place, about ½ in. of threaded shaft extended beyond the nut. Of course this could not be let go idle, so we hunted around and found a chuck that would take up to a ¼-in. drill and screwed this onto the shaft end.

It is surprising the number of uses we find for this equipment. It supplies compressed air for all kinds of cleaning jobs, spraying paint, for emptying oil drums into storage tanks, etc and does grinding, polishing and drilling on all kinds of maintenance jobs. It can be taken right out on the job and plugged into the nearest power outlet, and has proved a handy tool to have around.

Riverdale, N.Y. ALEX GRAY
Chief Engr, Colored Orphan Asylum

Sometimes a Job Can Be Too Good

A POORLY DONE JOB frequently causes trouble, but here's a case where trying to do a superior one led to difficulties. A sand and gravel company bought a 230-volt induction motor to drive a derrick and had it installed by a local electrical contractor. When the equipment was started the motor could do no more than lift the derrick boom and empty bucket. This indicated low voltage at the motor terminals, which a check with a voltmeter showed to be true.

Generally this condition results from long overloaded lines, overloaded transformers, low power factor and similar causes, but not in this case. The electrical contractor had been told that the derrick would be moved from time to time. To save rewiring the motor, he connected 150 ft. of additional wire, wound into a coil, in each motor lead. To make matters worse, he supported each coil on a heavy iron bar. These coils, because of their inductance, reduced voltage of the motor terminals to about 130 volts, which lowered motor torque about 66%. Cutting out the reels corrected the trouble and brought relief to the sand company.

Plainfield, N.J. H W HODGSON

ANYBODY *can cut prices, but it takes brains to make a better article.*—Philip D Armour

READERS' PROBLEMS

Questions for Our Readers

Repairing Cracked Chimney

Question 1

WE HAVE A BRICK CHIMNEY *with a 36 x 36-in. flue about 70 ft. high, which shows a crack all around the outside about 5 ft from the top. Can the chimney be made safe by pointing up the crack and placing iron staves at the corners or should the top be taken down and rebuilt?*—CCD

Reduce Head Pressure?

Question 2

AT ONE OF OUR FISH-FREEZING *and storage plants, condensing pressure is kept at 135 lb in preference to lower pressure, which could be had without additional cost. Better freezing time is claimed or there is some other benefit that I do not know about.*

We have 5 freezers (shelf coils, hand expansion valves) on the same floor level as our electric-driven vertical enclosed ammonia compressors. The power rate is 2¢ per kwhr and we have all the 55-F water we care to use in our condensers, which are plenty large. Backpressure is held at from 5-in. Hg vacuum to 5-lb pressure. It seems that it would be more economical to drop our condensing pressure to 90 lb or so. What do POWER *readers think?*—MC

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Stop Using Compound?

Answers to Aug Question 1

The Question

WE HEAT OUR *school system with 4 steel firetube boilers, 3 of which are more than 25 years old. Feedwater is good, with 65 ppm total solids, consisting of chlorides and some calcareous and silicious matter. Boilers show little scale and practically no pitting. We use only enough boiler compound to maintain a positive test with phenolphthalein indicator.*

We are now erecting a high school and doing some remodeling of heating plants in the present buildings. The heating engineer who designed the new plant and who is being consulted in remodeling work has advised discontinuing use of boiler compound entirely. He gives these reasons: (1) unnecessary in low-pressure boiler, (2) does not help in controlling scale and pitting in heating boilers, (3) interferes with proper working of return traps, and (4) causes rapid deterioration of radiator expansion elements and other delicate parts of the equipment.

This advice differs so much from our own rather limited experience and from counsel of others that we would like to get opinions from POWER *readers.*—JBM

Advice Is Good

SINCE JBM'S BOILERS are 25 years old, it is likely that the rest of the system is also that old, which means that it is probably a one-pipe hookup with radiators vented by air valves. The system is probably far from being air or even steam tight, especially as far as the air valves are concerned. Probably the system needs a lot more makeup than it should, and therefore, any impurities in the water will be more pronounced in their effect. At the same time, unless the water is extremely bad, it should not require treating, as even in the worst systems the makeup required would be only a small fraction of that required by industrial boilers.

If the old system is to be remodelled it is to be assumed that all radiators will be on a 2-pipe system with thermostatic traps, and there will be a return trap, or more probably a vacuum pump, at the boilers, in which case the amount of makeup will be negligible and after the first impurities have been deposited or blown out, the boilers will be operating on practically distilled water, virtually free from air.

Bloomfield, N. J. J O G GIBBONS

Stand on Record

IT SEEMS THAT JBM is up against the sort of thing that happens sometime to every plant engineer. Every once in a while a new-timer comes along who hasn't singed his eyebrows yet but is brimfull of ideas, and tells the old-timer that he is all wrong and doesn't know anything about this power game. I often wonder what would happen if the average plant engineer wasn't able to distinguish between the chaff and the wheat. To me, JBM has answered his own question, for if after 25 years of operation his boilers are in the condition he has described, the results of his care in operation and his ability to determine his own feedwater control should be recognized, and would be by any heating engineer worthy the name.

To say that feedwater treatment is unnecessary in low-pressure boilers and does not help in controlling scale and pitting is contrary to results obtained in practice. As regards interfering with operation of return traps and causing deterioration of radiator expansion elements and other delicate parts of the system, the engineer probably forgot that the condensate is distilled water and practically chemically pure. In a heating boiler there is little chance of carryover at such low pressures.

Ansonia, Conn. W T ESTLICK

Step-by-Step Answer

TO SIMPLIFY MATTERS, let's reply to the reasons given by the consultants as to why feedwater treatment shouldn't be used:

(1) As calcium carbonate, which is generally the largest amount of scale-forming salts in feedwater, has a low saturation point when heated, the boiler would have to be operated at an extremely low concentration point to be sure there would be no precipitation of calcium-carbonate scale.

(2) This depends on treatment. Some may not help and may, in fact, tend to exaggerate the scale. As an example, if scale is precipitated as calcium carbonate compounds, and if soda ash or caustic soda is used, there will be a tendency to reduce the solubility of calcium carbonate and force more of this material out of solution, yielding more scale than would be developed without this treatment.

(3) If the boilers are kept at the proper concentration for the rating at which the boilers are being operated, the chances of having any interference in return traps is negligible. The interference referred to is generally caused by carry-over and in modern boilers, where there is sufficient steam space for disengagement of steam, the only cause of priming or carry-over is the increased surface-tension which is caused by too high a concentration of soluble salts in the boiler.

(4) Besides being affected by carry-over, this can also be caused by the use of a soda-ash base compound, since the action of heat causes about 80% of the soda ash to become caustic and the 20% breaks up into carbonic acid and water. The carbonic acid, being volatile, passes over with steam and when the steam condenses it reabsorbs this gas so that water returning to the boilers and passing through radiators, etc, is in an acid state and thus causes deterioration.

Boston, Mass. H R McC

Need Treatment to Control Corrosion

JBM DOES NOT STATE whether the heating system is operating with a vacuum pump or depends entirely on return traps for getting condensate back to the boilers. If a vacuum pump is used, any leaks in radiators which may be shut off at the steam end, or in the return lines, will introduce

oxygen into the boiler with the water, which will cause corrosion and pitting unless prevented by proper treatment. In one particular case, corrosion occurred in a locomotive boiler which was fed by a return trap but which was allowed to cool down at night, thus establishing a vacuum in the system. Corrosion also occurred in water-tube boilers which were fed by a vacuum pump.

In both these cases the trouble has been greatly reduced by maintaining sufficient alkalinity with caustic soda to establish a pH of 11, or over, in the boiler water, along with sufficient tannin compound to keep a medium brown color in the water. No particular trouble has been experienced with traps under these conditions.

Altoona, Pa. A R MARKLAND

Try Stopping Compound

THE WATER USED for feed in JBM's boilers is certainly not undesirable, but to know if use of compound was warranted at all, one would have to know how it was formulated.

However, I do not concur with the heating engineer if his reasons are offered for other than specific instances. Treatment is *often* desirable in low-pressure boilers. Control of scale and pitting is possible, although the former is not usually as bothersome as boiler pressures decrease. Proper treatment and boiler operation (to avoid carryover) should not cause difficulties with equipment.

Since the boilers are over 25 years old and in good condition, one of two conclusions may be drawn. Either the compound is of an inert nature, doing neither good nor harm (outside of unnecessary expense) or it is doing its job satisfactorily in this case. May I suggest that as a practical check, use of treatment be discontinued for one year. The comparative condition of the boilers at the end of that time should be the answer.

Canton, Mass. H M SPRING

Shouldn't Stop

JBM SHOULD NOT DISCONTINUE use of compound. Experience has shown that not only is the boiler protected by water treatment but that return lines and radiators are kept in better condition. Unless proper treatment is present, acidity of return water increases due to carbon dioxide and corrosion generally results, especially if the system is not free from air. Unless used to great excess, no ill effects should be noticed in return traps or radiator expansion elements. Harm to these units is more likely to result from absence of treatment than from use, if properly controlled. If JBM has heating boilers, 25 years old, free from pitting and without scale, it is most probable that treatment is largely responsible. To stop now would be like turning against a loyal assistant.

Hartford, Conn. T J KIELY

Carryover Big Problem

IT WOULD APPEAR that the heating engineer in charge of JBM's job is better versed in design and construction than in boiler maintenance, otherwise he would not have given absurd reasons for stopping use of compound. Continued use is certainly indicated as long as the water contains calcareous and silicious matter.

Objection to treatment on the score that it interferes with trap and control operation sounds as if the heating engineer had been having trouble with carryover in a heating system. Carryover from a heating boiler, particularly where the boiler carries a heavy burden of sludge, will tend to gum up return traps. Proper blowdown will keep concentrations below danger point and will eliminate this trouble. Deterioration of radiator expansion elements could possibly be caused by caustic from carryover; under certain conditions this would attack brass parts.

Another serious, and usually neglected, phase of heating-system operation is corrosion of condensate-return lines—usually iron. Assume pure steam is being liberated in the boiler, from properly treated water; this steam will contain whatever oxygen and carbon-dioxide is contained in the boiler water. When this steam condenses, the gases dissolve in the water, rendering it mildly acid. The ferrous carbonate formed by attack of carbonic acid is oxidized to ferric form by the dissolved oxygen, resulting in rusting of return pipes. A useful method is to install a deaerating feedwater heater to remove gases from the feed. In a vacuum system particular care should be taken to prevent infiltration of air through leaky valves.

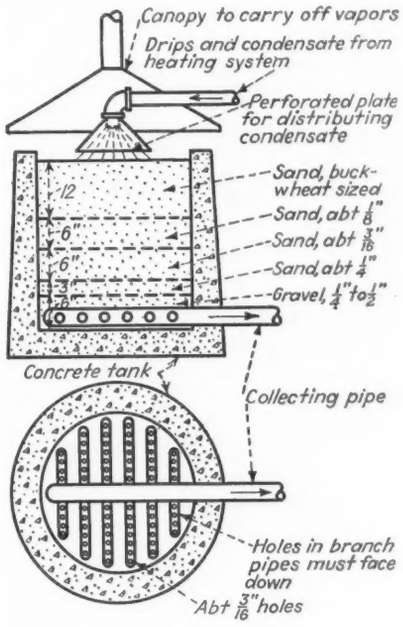
Fargo, N. D. LAWRENCE KIRK

Cooling Oily Drips

Answers to Aug Question 2

The Question

WE HAVE *a number of low-pressure drips, including those from exhaust-steam piping, a closed exhaust-steam feedwater heater, exhaust head and returns from the exhaust-steam heating system which are not suitable for returning to the boilers, as they contain considerable oil. These drips are sources of considerable nuisance and we must provide for better cooling of the hot water before it is discharged to the sewer. How can we dispose of these oily drips to better advantage?*—SAK



Fit Exchanger to Header

SAK'S PROBLEM can be solved by piping all drips to a common header and then cooling a portion of this header with makeup water on its way to the feedwater heater. The heat exchanger can be made up of pipe, usually available around a plant.

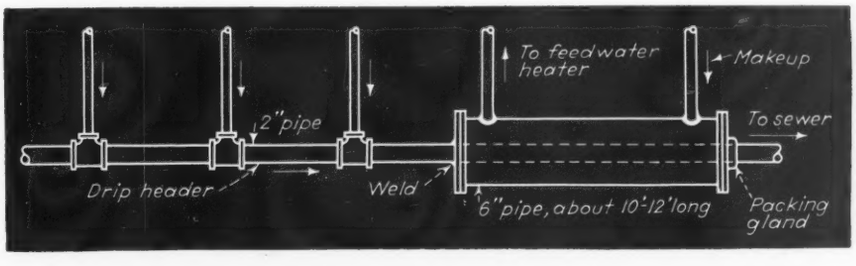
The question doesn't give the number of drips or the flow, but by using a common header of sufficient size, say about 2-in., and running this pipe through a section of 6-in. pipe about 10 or 12 ft long, a suitable cooler can be had for little cost. The sketch shows the general arrangement. One end is welded and the other end is fitted with a packing gland to allow for expansion.

Beaumont, Texas G F BRILL

Build Filter Tank

SAK APPARENTLY IS WASTING his good condensate in order to get rid of the oil mixed with it. He can solve his problem by constructing a tank as shown in the sketch and putting all condensate from drips and heating system through it. The tank is filled with gravel and various sizes of sand; the top layer of fine sand should be removed and replaced with fresh sand about once a week. The rest of the sand and gravel may be good for a year without changing.

From the tank, condensate should be directed into a hotwell by gravity and

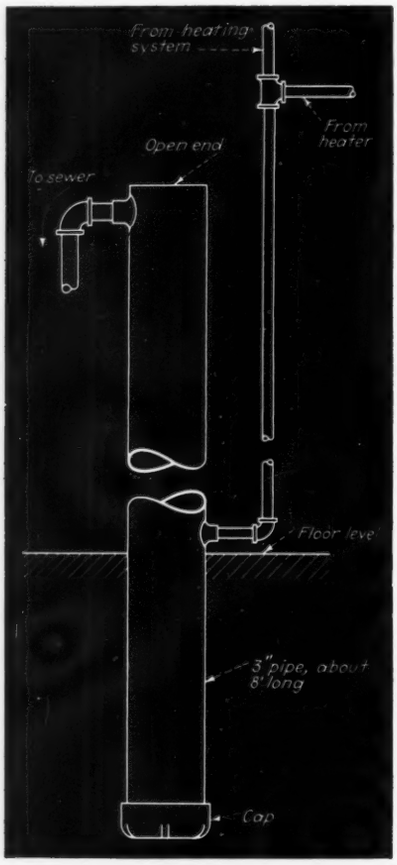


drawn from there by the feed pump. Between feedpump and boiler there should be a cloth oil filter of some kind. If a closed feed heater is used, install the filter between the pump and heater.

Toronto, Ontario J M FARRUGIA

Try Pipe Cooler

IF IT IS POSSIBLE to bring all oily drips together, the following can be tried: Connect all drip lines to a large pipe, capped at the lower end and sunk in engine-room



floor, vertically, as shown. The top is left open with an overflow connection to the sewer. This arrangement will cool the oily drips.

Grand Rapids, Mich. J M GORRIE

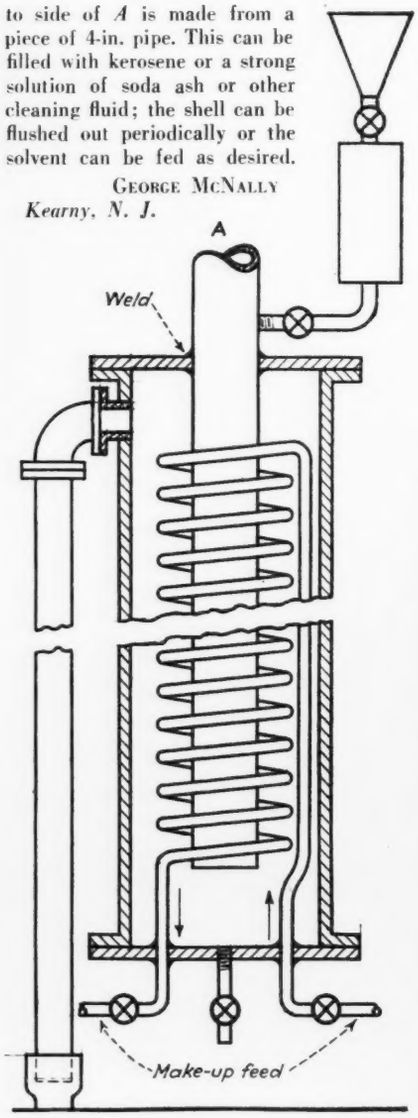
Make Heat Exchanger

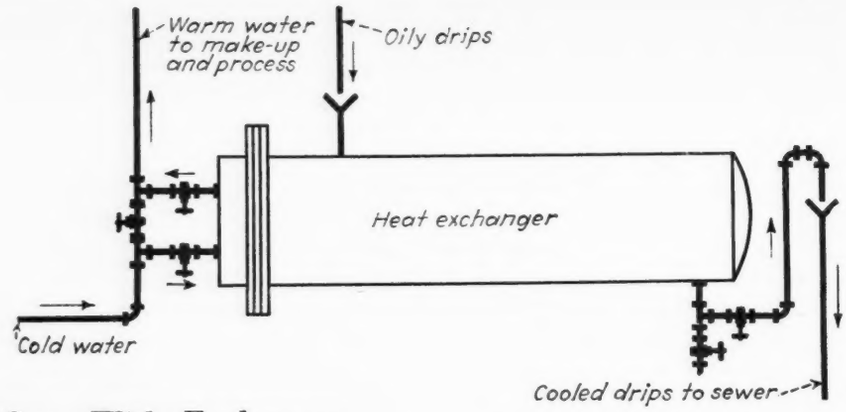
IF THE DRIPS can't be salvaged by a filter but must be wasted to the sewer, I suggest that SAK make a heat exchanger according to the sketch.

Have all drains led to a common line *A*. A piece of 12-in. WI or steel pipe 6 ft long, with flanges on each end, forms the shell. The ends can be cut from ⅜-in. plate and bolted as shown. Cut out top plate to take main drain line *A* and weld around as shown. Carry line *A* to within a few inches of the bottom of the vessel. Cut bottom plate to take ends of a 1-in. water line, the line to be coiled as shown, ends threaded, valves fitted and welded to bottom plate.

For convenience of cleaning the whole heating surface, the small vessel attached to side of *A* is made from a piece of 4-in. pipe. This can be filled with kerosene or a strong solution of soda ash or other cleaning fluid; the shell can be flushed out periodically or the solvent can be fed as desired.

GEORGE MCNALLY
Kearny, N. J.





Save With Exchanger

A SIMPLE WAY to cool the drips is to install a heat exchanger, connecting the drip lines to the shell and running the cold water through the tubes. Should warm water for process work be needed an extra quantity of cold water over and above the makeup could be passed through the heat exchanger before going to the process heaters.

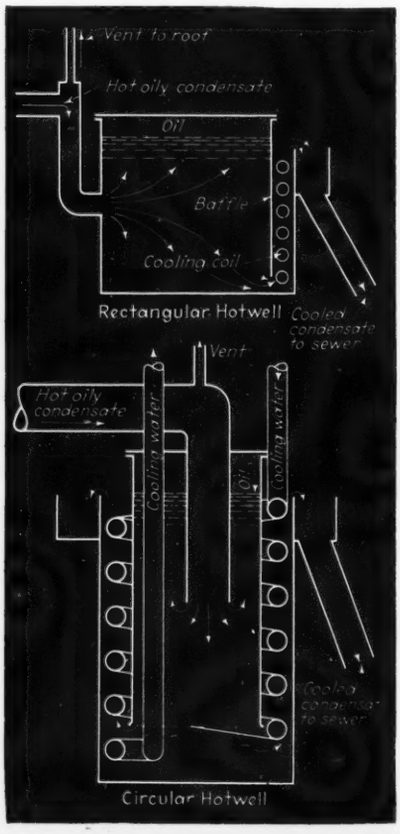
The size of heat exchanger most effective depends on the amounts of makeup and process water required and the quantity of oily drips available. Any reliable heat-exchanger manufacturer can give SAK the right-size equipment to get the best results. Extra storage for drips could be arranged easily, if rate of flow is not constant. The sketch shows one hookup for the exchanger.

Ottawa, Ontario D H MCCALLUM

Use Special Hotwell

NUISANCE CREATED BY VAPOR rising from hot condensate discharged to the sewer can be abated by using a hotwell with a cooling coil to lower condensate temperature. The sketch shows a hotwell embodying this idea. It can be placed above or below floor level, can be made of any suitable shape or dimensions, and of wood, metal, or concrete. If made of concrete it should be well painted to prevent oil absorption. Dimensions should be such that there is sufficient space for oil to separate from condensate.

Rochester, N. Y. JULIUS BRODSKY



ARGUMENT CORNER

More on the Water Column

THE COMMENT by C W Carter, Jr, page 109 August POWER, on my answer about checking the level of the water column of an hrt boiler, is correct. Paragraph P-291 of the ASME Power Boiler Code calls for 3-in. minimum clearance between the highest part of the tubes in an hrt boiler, and the lowest visible part of the gage glass.

The title of the original group of questions and answers was "Short Questions—Quick Answers," and apparently the question was a little too brief to indicate fully its intent and purpose.

One is sometimes called upon to check the elevation of a water column already piped up on a new installation. Oftentimes a level or convenient common elevation from which to secure an accurate measurement is not available. While several possibilities may be considered, that described is not only practical but very accurate. It is an easy matter for a man to enter the boiler and strike off a chalk line on the head 3 in. above the tubes. After this, the water level in the boiler may be raised until it just shows in the lowest part of the glass, and observation through the manhole with a flashlight will show if the water level is at least as high as the chalk line.

And as for the requirements of many states for leveling the water column so that the lowest visible point of the gage glass is 3 in. above the highest part of the tubes (usually the front ends), I do not think many intelligent engineers or boiler inspectors would quibble much if the distance were 3 in. from the low end of the tubes with a boiler of average pitch, in a non-Code state. I dare say that this condition exists on many boilers in Code States.

While it is appreciated that no rule should be broken if an accident might result, rules are considered by many to be guides as well as laws. A little common sense in the administration of rules is often desirable in gaining the cooperation of all concerned.

Canton, Mass. H M SPRING

Experience With Ash on Chain Grates

THE ARTICLE "Feeding Ash Protects Chain Grates", in the July issue, placed a timely emphasis on the value of ash in reducing maintenance costs when this type of stoker is used. It may interest some readers to know that feeding ash is also a means of preventing damage to some parts of plunger underfeed stokers, particularly when the unit is banked or is to be removed from service.

For several years following installation, we experienced a great deal of trouble with distorted retort push rods and burnouts of front furnace-wall retort-cover castings of our three single-retort underfeed stokers. We found that while affected parts were cooled by the entering row of coal during normal operation of the stokers, they frequently became overheated when the units were in standby service or when fuel in the retorts was allowed to burn down prior to shutdown.

Substantial maintenance savings have been made by feeding ash to counteract the conditions causing damage to these parts. When a unit is to be taken out of service, all coal in the hopper is pushed into the retort and then ash is fed until the fuel is forced out of the retort trough and onto the tuyeres, where it is readily burned without danger of burning the stoker iron normally protected from heat of the fire.

In the case of a dead bank, only enough ash is fed to protect the front-wall retort-cover section. With a live bank, protection is secured by operating the stoker plunger frequently enough to insure an adequate supply of green coal in the retort at all times, and feeding ash is not considered necessary.

Roanoke, Va. S H COLEMAN

Arches for Flat-Flame Burners

IN "NOTHING FANCY", page 98, June Operating Engineer, I see that the engineer of the plant described likes a flat-flame burner under an hrt boiler, because it "streamlines through the furnace and does not overheat the shell or girth seams". He also says he does not believe in targets or arches, and does not think that 3% of the steam used for atomization is objectionable.

I quite agree that in the case of the average low-set hrt boiler, the flat-flame burner has considerable advantage, but much of this is lost if the flame cannot be kept from licking the boiler drum. It is very important that the vaporized oil should not strike the boiler drum, or any surface which is at less than ignition temperature, before combustion is complete.

I presume that the arches objected to are something in the form of ignition arches. However, the sketch shows an arch at the rear of a boiler, a number of which have been installed with very satisfactory results. The firebrick wall, with two open arches, is built near the rear end of the boiler, about one foot clear of the blowdown. On small boilers, one arch may be sprung from wall to wall.

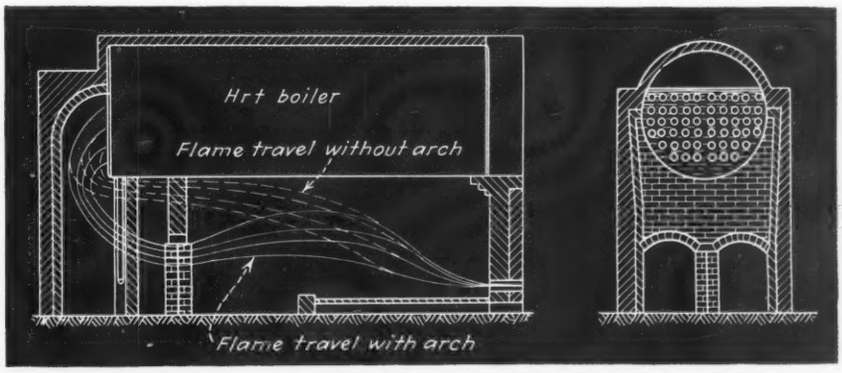
The flame of a flat-flame burner has a tendency to rise, and wipe along the boiler drum, but by making the arch about half the height of the boiler, the tendency can be overcome to a large extent. Result is protection of boiler seams, less soot, and no reduction in efficiency due to incomplete combustion.

The column between the arches is set diagonally, so that the flame will not impinge upon the brick joints. Experience shows that the diagonal set adds greatly to permanence of the structure.

As with all engineering problems, we must approach this one with an open mind. Both steam-atomizing and mechanical-pressure burners have their place, and there is no getting away from the fact that a mechanical burner, even when operated with a direct-acting steam pump, will not take more than about one-quarter the amount of steam estimated for the steam-atomizing burner. Moreover, it is quite a simple matter to figure out just about how much steam the pump will take, and you can be pretty sure that the amount will not be greatly exceeded in practice. On the other hand, there is hardly any limit to the amount of steam that can be wasted through careless operation of a steam-atomizing unit.

Given a high setting, and a fairly steady load, the mechanical burner should certainly receive serious consideration.

Bloomfield, N. J. J O G GIBBONS



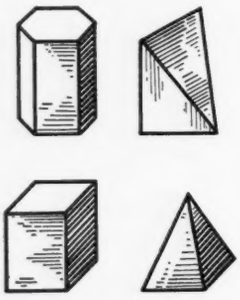
Arches prevent flame from licking boiler drum, thus preventing vaporized oil from striking a surface that is lower than ignition temperature before combustion is complete

Surfaces of Solids

By Phil Swain

Headwork Section for July and August showed how to figure flat areas. Here are simple rules for surface areas of solid shapes often met in engineering work

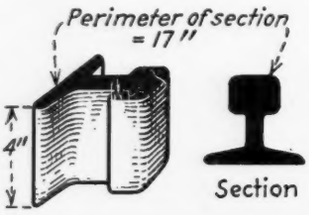
FLAT-SIDED SOLIDS



Rule: Where all sides are flat, figure area of each side and add.

Note: If all sides are flat, each side will be a rectangle, triangle, or other figure with straight sides. So use rules given on page 106, July POWER.

CONSTANT SECTION

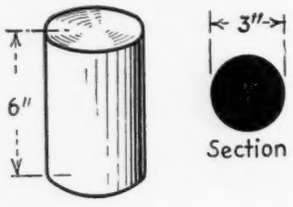


Note: Refers to bodies (such as bar stock or structural steel shapes) which always show same section, wherever sawed.

Rule: Measure perimeter of section (distance around outline of section). Area of side surface = perimeter × length of piece (assumed to be sawed square).

Ex.: 4 in. × 17 in. = 68 sq in. of side area. Area of ends figured as shown for irregular flat shapes on page 110, August POWER.

ROUND CYLINDER

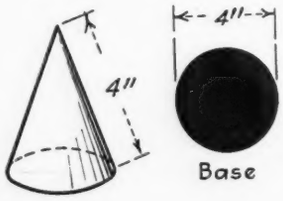


Note: This is a special case of the preceding. Here, perimeter of section is circumference of circle.

Rule: First, circumference = 3.1416 × diameter. Second, side surface area = circumference × length.

Ex.: Circumference = 3 × 3.14 = 9.42 in. Side surface area = 9.42 in. × 6 in. = 56.52 sq in.

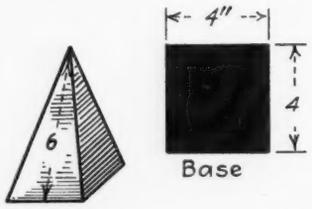
RIGHT CIRCULAR CONE (ORDINARY CONE)



Rule: First, circumference of base circle = 3.1416 × diameter. Second, side surface area = ½ × slant height × circumference of base circle.

Ex.: Circumference of base circle = 3.14 (approx.) × 3 in. = 9.42 in. Side surface area = ½ × 4 in. × 9.42 in. = 18.84 sq in.

REGULAR PYRAMID



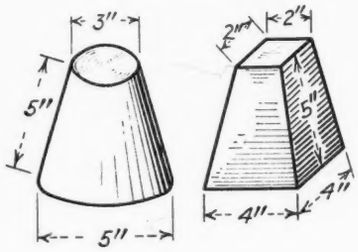
Rule: Side surface area = ½ × slant height × perimeter of base.

Note: Measure slant height up center line of panel.

Ex.: Perimeter of base = 4×4 in. = 16 in. Side-surface area = ½ × 6 in. × 16 in. = 48 sq in.

Note: Same rule applies to a triangular pyramid.

FRUSTUM OF REGULAR CONE OR PYRAMID



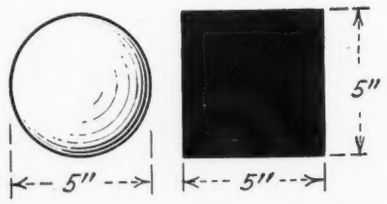
Rule: First, average perimeter = half sum of top perimeter and bottom perimeter. Second, side-surface area = average perimeter × slant height.

Ex.: (Cone)

Top perimeter =
3 in. × 3.14 = 9.42 in.
Bottom perimeter =
5 in. × 3.14 = 15.70 in.
Sum = 25.12 in.
½ Sum = 12.56 in.
Side-surface area = 12.56 in. × 5 in. = 62.8 sq in.

Ex. (pyramid): Top perimeter =
4 × 2 in. = 8 in.
Bottom perimeter =
4 × 4 in. = 16 in.
Sum = 24 in.
½ Sum = 12 in.
Side-surface area = 12 in. × 5 in. = 60 sq in.

SPHERE



Rule: Surface area of sphere = 3.1416 × area of square whose side equals diameter of sphere.

Ex.: Area of square = 5 in. × 5 in. = 25 sq in. Surface area of sphere = 25 sq in. × 3.1416 = 78.54 sq in.

[*Headwork Section for November will show how to figure volumes*]

HOW TO APPLY ARTIFICIAL RESPIRATION

ELECTRIC SHOCK and gas poisoning rank high among power-plant hazards. Both cause stoppage of breathing, and for both the *best* treatment is *immediate* application of artificial respiration. In such an emergency, the man on the spot who knows resuscitation procedure is worth a whole college of surgeons.

These pictures show how to apply respiration by an approved method. Study them, then practice. Better yet, try having regular practice sessions for the men in your plant as often as convenient. Being ready to meet the emergency when it arises may mean the difference between life and death.

General Instructions

THE FIRST MINUTES win or lose the fight —start resuscitation *immediately*, and keep it up without interruption. Send someone else for the doctor, even if it means waiting until others arrive.

In electric shock, the first job is to break contact. Use any handy non-conductor, but if you don't want to add another victim to the accident, don't use your hands without protection. In gas poisoning, get the victim into fresh air immediately, preferably into a warm place. Put on proper protective equipment, such as self-contained oxygen breathing apparatus, before entering gas-filled space. Without these, a quick dash must be chanced. Remember that carbon-monoxide gives no warning and hits the legs first—you may lose power of motion before you are aware of it. Don't depend on a handkerchief tied about the nose and mouth. This will only filter out the irritating fumes and offers no protection against carbon-monoxide.

Rhythm

Learn to repeat this sequence of operations smoothly and rhythmically. Counting aloud helps. Space counts at one-second intervals. At "One", hands are placed and forward swing starts, at "Two" the shoulders are directly over the heels of the hand, at "Three" pressure is released and body swings back to take the relaxed position during count of "Four" and "Five". Repeat cycle 12-15 times per minute.

CONTINUED ON FOLLOWING PAGE

1—By using one arm as a pivot and pulling on the other, even the heaviest man can be easily turned on his belly. Closeup shows one arm extended directly overhead, the other bent at the elbow. The face turns outward, resting on hand or forearm to keep nose and mouth free for breathing. Don't waste time loosening clothing or feeling in mouth for foreign objects such as tobacco, gum, or false teeth. These steps should be taken by an assistant, after resuscitation is underway

2—Straddle the victim, taking the position shown. Knees should be about halfway between victim's knees and hips and should press victim's legs together. Palms should rest on small of back, with fingers on ribs, little finger just touching lowest rib. This is important — placing hands too high may cause a rib injury, placing them too low puts pressure on kidneys where it does no good and may do harm

3, 4—Swing forward, gradually bringing your weight to bear. Keep arms stiff. Shoulder should be directly over heel of hand. After about two seconds, release pressure gradually by swinging back on your heels and letting hands drop. Learn to relax completely —every bit of rest gained makes it possible to continue resuscitation that much longer

HOW TO APPLY ARTIFICIAL RESPIRATION

5—The relief operator takes up a position at one side, ready to take over when the working operator signals

Changing Operators

When more than one man trained in resuscitation is available, operators should relieve one another at frequent intervals. These pictures show how the shift is made without interrupting rhythm of respiration

6, 7—The working operator moves to one side, as shown, and carries out one cycle of pressure and release from that position. The relief operator moves in closer, turning slightly to one side, ready to take over. He performs the next cycle, from the side as shown, while the former operator moves out of the way

8—The relief operator then continues resuscitation from the straddle position. Remember, the important thing is to maintain the rhythm during the change

Pictures posed in McGraw-Hill Studios by B W Byrnes and A E Erickson, Supervising Instructors, Dept of Resuscitation and Related Activities, Consolidated Edison Co of N. Y., Inc.

FINAL POINTERS

DO NOT GIVE any liquids by mouth until the victim is conscious. If no doctor is present when the patient revives, give some stimulant such as a teaspoonful of aromatic spirits of ammonia in a small glass of water, or a hot drink of coffee or tea. Avoid heart strain by keeping the patient still after revival.

Apply resuscitation as close as possible to the spot where the accident happened. Don't move the victim until he breathes normally, and then only in a lying position. If extreme weather conditions or other considerations make it necessary to move the victim before he resumes breathing normally, keep up artificial respiration during the moving.

Unconscious persons chill rapidly and careless exposure of the victim of an accident often results in pneumonia. Keep the victim warm at all times. Cover him with coats or blankets (there is a special procedure for wrapping the victim in a blanket without interrupting resuscitation—it will be described in a future issue). If hot pads are available, slip them under the victim so the body rests on them. Place hot bricks along the sides from armpits to knees. Placing the body so that head is six or eight inches lower than feet will promote flow of blood to heart and improve circulation.

Particularly in gas-poisoning cases, where breathing oxygen helps drive carbon-monoxide from the body, inhalation treatment is desirable. Utility companies, hospitals, police and fire departments have such equipment and they should be called. Remember that inhalation treatment is used in conjunction with artificial respiration and that the latter is the first resource in gas-poisoning or electric-shock cases.

In some cases, an apparently revived patient will suffer a relapse and breathing will cease. Keep a close watch on the patient for several hours, ready to apply artificial respiration in case breathing stops.

Above all, don't give up hope until there is positive medical evidence that the patient is dead. Victims have been revived after having been worked on for as long as eight hours, and have been revived after being pronounced dead by doctors. In any case of electric shock or gas poisoning, apply resuscitation no matter what the apparent condition of the victim and keep it up!

"Soon I'll have fun," snarled
demon DUST,
"I'm hot when I get goin',
These contacts here will
shriek with pain
When I lay on 'em prone."

But his proud boast soon
came to naught
The contacts laughed in glee,
"Sir, Cutler-Hammer
know their stuff
They built us VERTIC'LY!"

VERTICAL CONTACTS mean better Motor Control. Dust between contacts causes heating and burning. But dust *can't* settle on VERTICAL contacts. So Cutler-Hammer VERTICAL CONTACTS need not be buried. They're *out in the open* . . . always air-cooled, easily inspected, fully accessible—yet free from dust and dirt. Get the facts. Send for free book, "Dust, the Destroyer." CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1358 W. Paul Ave., Milwaukee, Wisconsin.

ONLY VERTICAL CONTACTS CAN BE DUST-SAFE!

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MOTOR CONTROL
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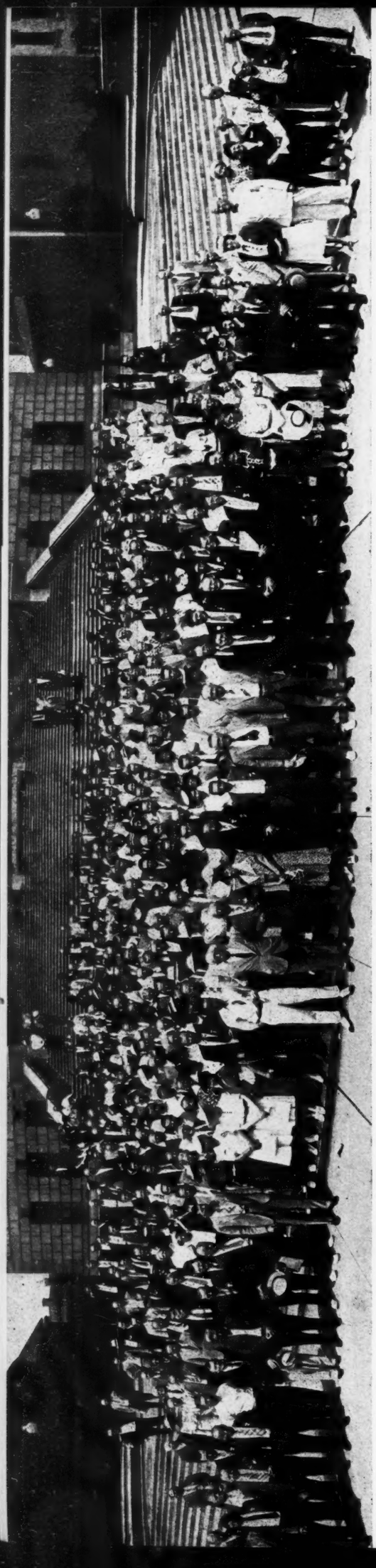

NAPE Meeting Tackles Engineering Problems

INDIANAPOLIS, IND., SEPT 3—This city was the 1939 convention city to the National Association of Power Engineers, from Aug 28 to Sept 1, with approximately 3000 members and their friends in attendance (see photo at left). The Hotel Claypool served as headquarters, while the power-equipment exhibit and all meetings, except one, were held in the Murat Temple. Both the meetings and power-equipment exhibits were well attended.

On Monday morning, Aug 28, the 38th Annual Power-Equipment Exhibit was officially opened with Secretary Bob Jones as chairman of the meeting. After paying tribute to the spirit of cooperation that has existed for so long between the makers of power-plant equipment and operating engineers, he expressed his deep appreciation to the association and local committees for the outstanding exhibit of equipment.

Official opening of the 57th Annual Convention of the N A P E took place in the impressive auditorium of the World-War Memorial Building, with D C Hess, chairman of the local convention committee, occupying the chair. T A Dicus, state-highway engineer, acting for Governor M Clifford Townsend, discussed safety in general, giving particular attention to highway safety. President Fred C Laufketter, responding, emphasized the safety problems before this country and their importance to the public in connection with power-plant operation. Other speakers included city-attorney Reddington, representing Mayor R H Sullivan, national vice-president Carl Daubenmire and George Olive, representing the Chamber of Commerce.

Purdue Day

Wednesday was Purdue Day, with a lecture, "If I Were Again an Operating Engineer", at the morning session by William T Miller, associate professor of heating and ventilating, Purdue University. At the afternoon session, A A Potter, dean of engineering, Purdue University, discussed the problems before the operating engineer.

Prof Miller's conclusions were that, if he were again an operating engineer, he would select a job in a large modern building. His talk was devoted to air-conditioning problems which he defined as comfort engineering. Comfortable conditions can be maintained by control of temperature, humidity and air movement. In the past, air conditioning has been frequently used in a way to produce discomfort, and in some cases shock, sufficiently severe to cause prostration of persons coming out into the open. Operating engineers must be familiar, said Professor Miller, with the requirements for proper air conditioning and to control these for maximum comfort.

Dean Potter said that mechanical power aided by science and engineering has altered the world during the last 70 years. Power is indispensable to community life, to national security and to all types of industry. The steam plant is now and is bound to remain for a long time the most important unit for stationary work.

After reviewing the trends in steam power-plant design and operation, the Dean expressed the opinion that no revolutionary changes in steam power plants seemed to be in store for the immediate future. The next few years, he said, will see a consolidation of the best experiences of the last two decades. Steam temperatures are bound to go up to 1000 or even 1100 F as soon as research points to suitable alloys for such temperatures. It is unlikely that steam pressures higher than 2500 lb will be used even if temperatures of 1100 F prove practical. Plant efficiencies will be higher, availability of power-plant equipment will be greater and better, feedwater will be more easily secured.

There is bound to be considerable progress in plant instrumentation and control devices. Reliability and efficiency rather than low cost of plant equipment will be more fully appreciated, and definite efforts will be made toward simplification in the design of power-plant equipment, including piping. Greater intelligence and eternal vigilance on the part of those who design and operate power plants are bound to receive greater recognition and better reward. This country is a most favored nation in material resources and in the fine quality of its creative people. It has a great spiritual as well as material wealth. It has a solid foundation upon which a new era of prosperity is bound to rise in the very near future.

Taking the preamble of the association as his text, at the Thursday morning session, S C Casteel, state president of Iowa N A P E discussed the N A P E and its ideals. He said that members of the association work with and assist their employers, believing that cooperation between them will result in greater benefit to both. It was president Casteel's opinion that the educational program of the N A P E is saving American industry millions of dollars each year due to more efficient plant operation. Conservation of our fuel supply is one of our great national problems, and in this, the power engineer is the most important factor, but is frequently hampered by management.

National officers elected for 1940 are: president, C R Daubenmire, Columbus, O.; vice-president, Alfred Butcher, Pittsburgh, Pa.; past president, Fred C Laufketter, St. Louis, Mo.; secretary, Fred W Raven, Room 1717, 176 Adams St, Chicago, Ill.; treasurer, Edward J Burke, Philadelphia, Pa.; trustee, C A Nelsen, Minneapolis, Minn.; conductor, H H Foreman, Los Angeles, Calif.; and doorkeeper, W F Severance, Tillamook, Ore. The next national convention will be held in Columbus, O.

ORDERS and *REORDERS*

Yes — steam traps, too, can be "known by the company they keep".

For when leading industrial plants, utilities, institutions and public buildings such as these—discriminating buyers who insist upon proof of a product's merit—order and *reorder* Yarway Impulse Steam Traps in constantly growing quantities, year after year, it can mean only one thing. They must be better steam traps. They must offer real economies in installation, in maintenance, in fuel, and in general plant efficiency. They do. Here is how they do it.

LOW IN PRICE—Yarway Traps usually cost less to buy than to repair other traps.

EASILY INSTALLED—Light in weight, they need no support.

LESS MAINTENANCE—Of rugged bar-stock construction throughout. Only one moving part—a simple valve. Valve and seat of stainless steel, heat-treated for long life in severe service. Cold rolled steel body bright cadmium-plated, inside and out, for permanent rust-free finish.

LOW RADIATION LOSS—Due to unusually small size.

HIGH EFFICIENCY—Quicker heating, no air-binding, no priming necessary.

If you are not yet one of the many thousand Yarway Impulse Trap users, find out the facts for yourself.

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Power Lines

$4,000,000 Plant for Alabama Power Co

Large-scale refunding and construction operations have been announced by the Alabama, Mississippi and Georgia power properties of Commonwealth & Southern Corp, following sale of the Tennessee electric facilities to TVA and 34 municipalities and cooperatives in August.

Initial plans call for the building of a $4,000,000 steam-electric generating plant in Mobile by the Alabama Power Co. Thomas W Martin, president, stated that the new 40,000-kw plant is the first of three units to be built at Mobile. It will be the first new Alabama plant to be constructed since the TVA was organized.

Turbines of Today Compared with Yesterday's

A $1,000,000 steam turbine with an efficiency 10% below present levels would prove to be a money-loser in operation, even if the manufacturer gave it away free and the user had no original investment to take into consideration, R S Neblett, assistant manager of the General Electric Co Turbine Division, told a meeting of the American Society of Mechanical Engineers at Dallas, Tex., recently.

Mr Neblett emphasized strongly that reliability and efficiency are of the utmost importance in electric-power-producing equipment, and that both must be built into steam turbines if they are to obtain profitable economy in operation.

A thousand dollars per day was cited as the approximate loss sustained by a utility when a 25,000-kw turbine gets out of kilter. In addition it costs about $5000 just to open up a turbine and find out what is wrong with it, according to Mr Neblett.

"Turbines manufactured in this country are much more efficient and compact than those produced abroad and as a result the American machines have a greater reliability," Neblett said. He used a large chart based on reliability figures obtained from utility groups here and in Germany to show that the average General Electric turbine produced 40% more kwhrs of electricity than the average German machine of the same rating over a 3-year period beginning in 1935.

The greatly decreased fuel consumption of modern turbines compared with those of 20 years ago was offered as an indication of the tremendous improvement achieved over that period. The average 30,000-kw station of 1918 needed $3500 worth of coal daily for its operation whereas today's average station of the same rating produces the same amount of power on a mere $1450 ration, according to Neblett.

The speaker attributed a big share of this saving to a better understanding of metals, and improved designs which have permitted the use of higher steam temperatures and pressures in turbines.

"There is a very definite trend toward the use of high-temperature, high-pressure superposed turbines," Neblett said. "These turbines installed ahead of units already in service have enabled many old stations to generate well over 30% more power for the same amount of fuel."

Hydrogen-cooled turbine-generators are becoming increasingly popular and represent a major advance in the industry. He said that the use of hydrogen in place of air as the cooling agent results in a gain of nearly 1% in full-load efficiency and increases the output per pound of material about 20%. Eight hydrogen-cooled units representing a combined capacity of 440,000 kw have been built by General Electric and installed by utilities since 1937.

Wyman Adds Third Unit

Orders for a third generating unit consisting of a 34,000-hp, vertical Francis type Allis-Chalmers water wheel and a 26,667-kva, General Electric generator have been placed by the Central Maine Power Co, Augusta, for installation in the Wyman station at Bingham, on the Kennebec River. Three 8889-kva Westinghouse oil-insulated, forced cooling transformers have also been purchased for this plant. The new generating unit will round out the original design of the station, and will enable the company to utilize water more efficiently in connection with the operation of Wyman, and the neighboring Solon station, which has been in operation for about a month and a half.

Lincoln, Monsanto Pledge No Price Rise

Leading the way in a stand against profiteering, Lincoln Electric Co and Monsanto Chemical Co on September 14 announced that both would maintain present prices as far as possible.

James F Lincoln, president, in a statement of policy issued to the press, pledged the Lincoln Electric Co to resist the inflationary cycle and asserted that price inflation by the seller, when he has a dominant position in instances like the current war-buying boom, inevitably results in deflation, depression and suffering.

The Monsanto statement said in part, "We have carefully reviewed our raw materials and in the case of most of the important ones, we cannot now see any reason for a precipitous rise in their cost.

"In the unforeseen event of demands beyond our capacities, it will be our policy to provide first for our present customers regardless of other inducements that may be offered."

OBITUARIES

KIRKE P SANBORN, 69, chief engineer of the Reading, Mass., municipal electric light dept and a staff member of the organization for 33 years, died in Reading, Aug. 8.

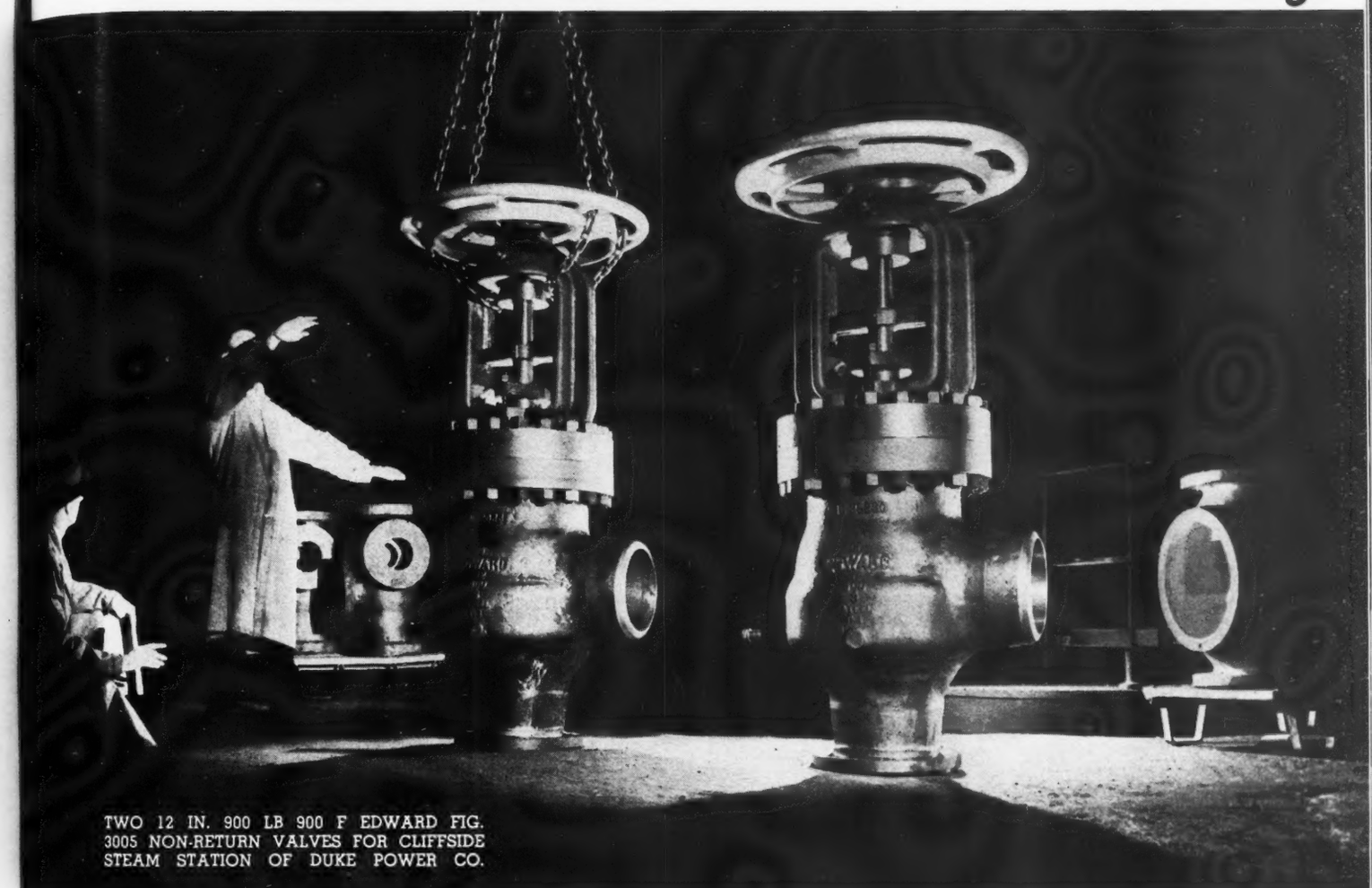
G ALBERT ROGERS, 45, coal inspector for Union Electric Coal Co, at DuQuoin, Ill., died Aug. 22 in St. John's Hospital, where

——*Wide World Photo*

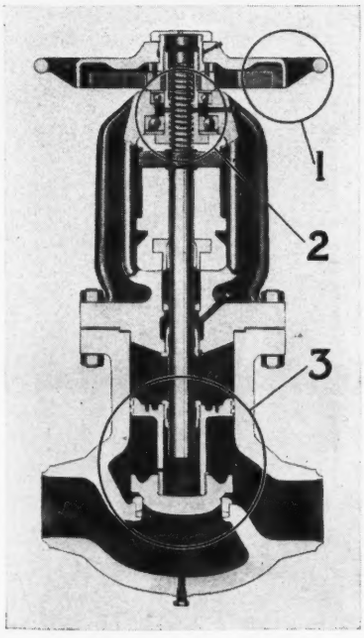
THE LION AND THE LAMB

David E Lilienthal (left), director of the TVA, and Wendell L Wilkie, president of the Commonwealth & Southern Corp, put the finishing touches to the sale of the Tennessee Electric Power Co to the TVA and cooperatives

..and, best of all, Edward Non-Return Valves Save Money



TWO 12 IN. 900 LB 900 F EDWARD FIG. 3005 NON-RETURN VALVES FOR CLIFFSIDE STEAM STATION OF DUKE POWER CO.



THREE EDWARD WINNERS

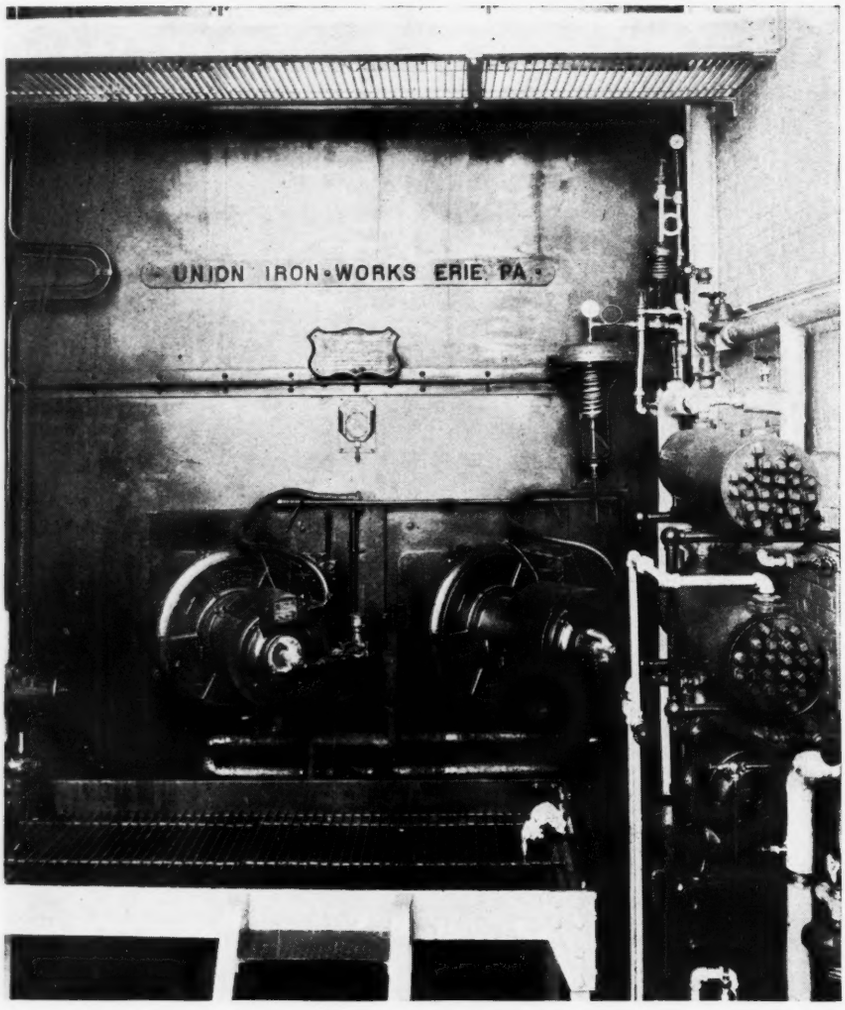
Designed for tomorrow's record-setting power plants, new Edward non-return valves embody refined but time-tried basic principles worked in with new but proved materials. Cross section shows three valuable details—(1) Impactor handwheel, (2) EValthrust yoke bushing, and (3) hourglass disk-piston assembly. Edward Impactor handwheel is a "must" auxiliary for speedy emergency operation and for leakless closure during boiler tests. EValthrust yoke bushing, with angular thrust ball bearings, is distinctively of globe valve origin. Cut shows a Stellited seat welded in the globe body.

WHEN you install Edward non-return valves you do more than post sentinels at the outlet of steam generating units. These valves, used predominantly in high pressure boiler plants throughout the land, meet all routine needs in the way of preventing back flow or of providing positive shut-off when the boiler is down. They are available for all working conditions, are often adopted to good effect for unusual flow control problems in technological processes and, best of all, they save money by their freedom from operating trouble, low up-keep cost, and minimum pressure drop. Every Edward non-return valve embodies the essentials of free flow areas, open self scouring guides, EValloy piston rings, integral dashpot with freedom from differential thermal expansion problems, and hourglass pistons. These features characterize the two welding end valves above, photographed before removal of inlet test flanges. On your next job, specify Edward valves.

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

EDWARD Valves

STOP • CHECK • BLOW-OFF • NON-RETURN
FEED-LINE • RELIEF • BLEEDER LINE • ETC.



MODERNIZATION PRODUCES RESULTS

New 4000-sq-ft Union Iron Works Boiler, recently installed in the Marblehead, Mass., municipal plant, burns fuel oil and supplies 210-lb steam at 125 F to a remodeled turbine-generator. Engineers report that in a 16-hr run, the turbine and boiler produced 7900 kwhr at an over-all cost of 1.007 cents per kwhr. Cost of the new boiler installed with auxiliaries was $38,971

he was to have undergone an operation.

CARL LAGER, president, Morris Machine Works, Baldwinsville, N. Y., died at his summer home in the Adirondacks July 17. He had been with the company for almost 50 years, holding the positions of chief engineer, general manager, vice-president, and in 1935, president. Mr Lager was noted for his work in improving pumping machinery for waterworks, sewage plants, drainage systems, etc. He was born in Stockholm Sweden, in 1869 and came to the United States in 1887. He became a draftsman and foreman for the Allsing Co of Brooklyn, and later was employed by Henry R Worthington in Brooklyn. He was a member of the American Society of Mechanical Engineers for 45 years, and was honored with life membership.

PERSONALS

CHARLES A CRIQUI, Sr, founder and for 35 years president of the Sterling Engine Co, has announced that he will turn the active direction of the company over to younger executives, and will take a less active part in the operating of the business. He will serve, however, as chairman of the board, as well as on the executive committee. Spencer H Logan and Addison P Vars, of New York and Buffalo, will take over the presidency and executive vice-presidency, respectively.

F A WRIGHT has been appointed manager of resale sales of Cutler-Hammer, Inc Milwaukee, Wis., replacing B M Horter, recently appointed general sales manager. He will have his headquarters at company's offices in Milwaukee. Mr Wright was graduated from the University of Michigan with a degree of Electrical Engineering, and has been with the company since 1927. Prior to his appointment, he was active in the company's St. Louis territory.

VLADIMIR KARAPETOFF, professor of electrical engineering in the College of Engineering, Cornell University, has retired and was recently made professor emeritus by the Board of Trustees. Born in Petrograd, Russia, he came to America in 1902 and joined the faculty in 1904 as assistant professor, becoming professor in 1908. Since 1933 he has been a trustee of Ithaca College, and is a member of numerous technical societies in the United States.

J H VOGEL, formerly assistant works manager of York Ice Machinery Corp, York, Pa., was recently made general works manager of the corporation. Mr Vogel first entered the employ of the corporation in 1915 as an apprentice in the industrial course. Soon after, he entered Penn State and worked with York during his vacations. Upon his graduation he continued as outside erecting engineer and later held other positions with the same company. In 1934 he was appointed assistant works manager in charge of methods and equipment.

FRANK C MACKRELL, for the past 10 years district manager of American Locomotives Co's Diesel Engine Div, has joined the New England sales office of the Allis-Chalmers Mfg Co, Boston, where he will specialize in naval, marine, and steam-turbine work.

ROBERT E HUNT has been appointed engineer in charge of research and product development of the Wilkening Mfg Co, Philadelphia, Pa. Prior to his joining the company he was in charge of engine development at Reo Motor Car Co.

G P AIRHART, of the engrg dept at Pittsburgh office of General Electric Co, has been appointed engineer at the Baltimore office. After graduating from the University of Pennsylvania in 1923, Mr Airhart entered the employ of the company in the student test course at Schenectady. In 1925 he joined the construction force at the Philadelphia office, and five years later went to the Pittsburgh office in the engrg dept.

GEORGE B COMFORT, associated with the company since 1924, has been appointed manager of sales promotion of Schramm, Inc, West Chester, Pa. He has served in the capacity of factory manager and more recently as manager of engineering sales.

LAWRENCE E JOSEPH has been appointed executive officer in charge of the Blaw-Knox Div of Blaw-Knox Co. He succeeds R F McCloskey, Sr, who was placed in

Lawrence E Joseph

charge of development of new products for the entire corporation. Mr Joseph was formerly manager of the National Automatic Tool Co, and prior to that was vice-president of Liggett Spring & Axle Co.

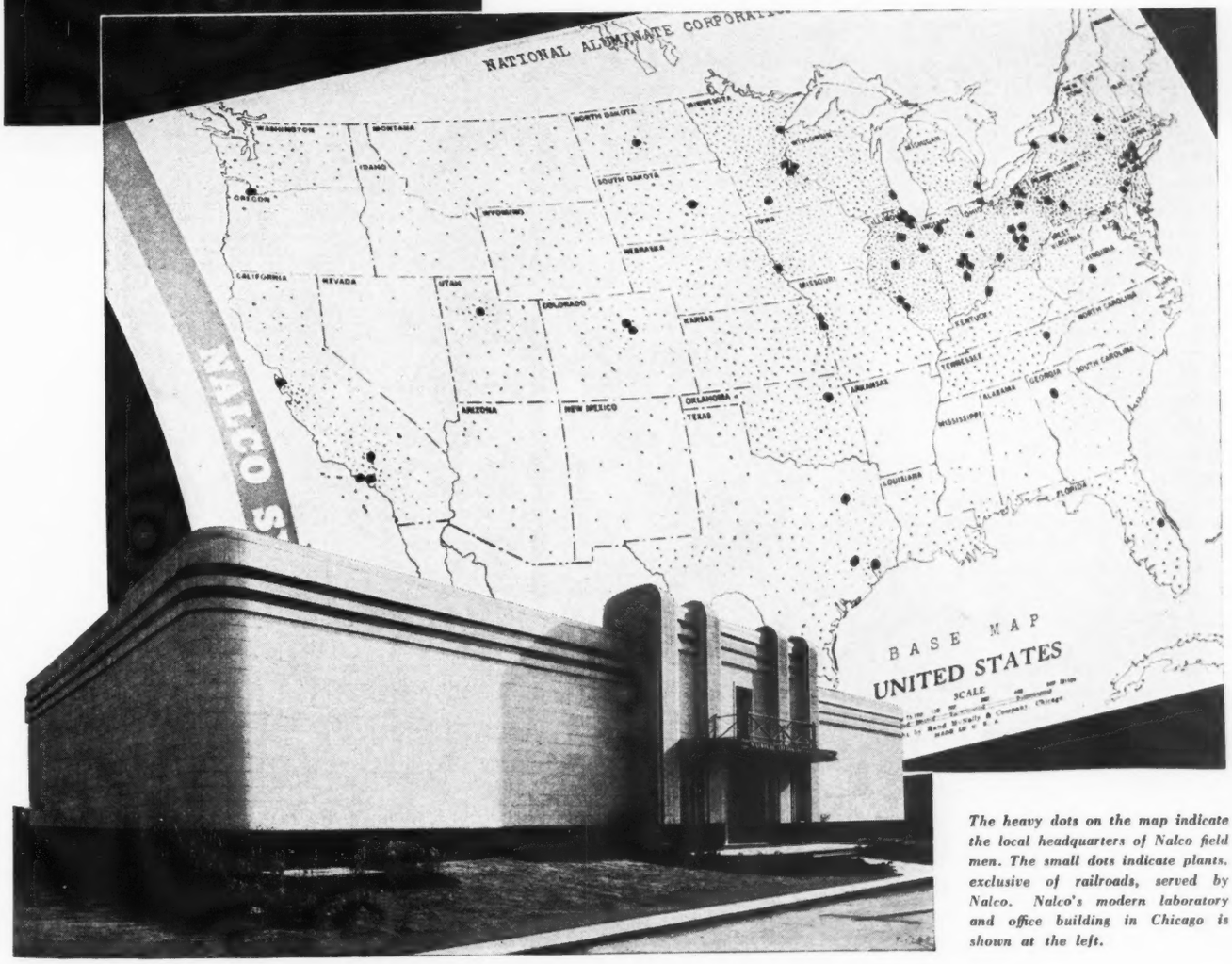
ELWOOD BACHMAN, industrial sales dept, General Electric Co, Salt Lake City office, has been made engineer of that office, suc-

NALCO SERVICE COVERS THE COUNTRY

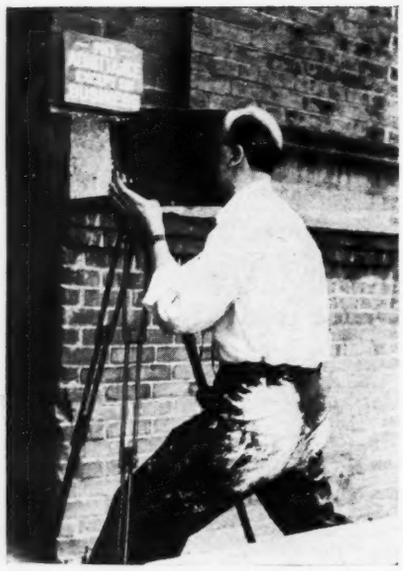
NO MATTER in what part of the country you are located, Nalco service is near at hand to bring you the Nalco System of Feedwater Treatment. As shown by the accompanying map, in most places you will find long-time Nalco customers all around you—plants so prominent that if you judge Nalco by the company it keeps, you will accord it highest rank. If you would like to ask users near you what they think of the Nalco System, we will be glad to furnish you with names on request. Write.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place **Chicago, Illinois**

Inquiries other than domestic, except those from U. S. Possessions, Canada and Mexico, should be addressed to ALFLOC, LTD., Bush House, Aldwych, London, W. C. 2, England. Canadian inquiries should be sent to ALUMINATE CHEMICALS, LTD., 372 Bay Street, Toronto, Ontario.



The heavy dots on the map indicate the local headquarters of Nalco field men. The small dots indicate plants, exclusive of railroads, served by Nalco. Nalco's modern laboratory and office building in Chicago is shown at the left.



EDITOR AT WORK

Photo snapped by engineer of a Connecticut plant disproves long-time belief that editor's pants get shiny from extensive contact with swivel chairs. What looks like shine is really asbestos, which got on seat of POWER editor's pants when he climbed over insulated piping to get a picture of a boiler

ceeding Dr H T Plumb, retired. Mr Bachman is an alumnus of the University of Utah, with a B S degree in Electrical Engineering. He entered the company in 1916, and since then has held numerous positions, the last one being salesman in the power & mining dept, which was reorganized as the industrial dept in 1924.

CYRIL LEECH has been appointed manager of the Philadelphia office of Frick Co, Waynesboro, Pa. Mr Leech is a graduate of the Portsmouth Engrg School, Portsmouth, England, and has been engaged in refrigerating engineering work since 1922.

EDWARD H BARRY, formerly supervisor of power, West Virginia Pulp & Paper Co, announces opening of office at 80 Federal St, Boston, Mass., for the practice of consulting engineering.

GEORGE HINSHAW, chief chemist at Goodyear Tire & Rubber Co, Akron, Ohio, has been made production manager for all Goodyear factories outside the United States. His new duties include supervision of production at tire factories in England, Australia, Sweden, Argentina, Brazil, Java, and Canada. He joined the Goodyear company in 1917.

FRED G GRONEMEYER has been promoted to plant manager of the Springfield Plant of the Plastics Div, Monsanto Chemical Co. He has been resident engineer for the plant since April of this year and has been with the company since May, 1929.

BUSINESS ITEMS

T B WOOD'S SONS CO, Chambersburg, Pa., announces following appointments:

(*Continued on page* 134)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ala., Birmingham—U. S. Steel Corp., Brown Marx Bldg., plan constructing addition to tin plate plant. $5,000,000.

Ala., Mobile—Alabama Power Co., 600 N. 18 St., Birmingham, asked permission of Alabama Pub. Service for construction 40,000 kw. steam plant, industrial area, Mobile. $4,000,000. Private plans.

Ark., Conway—Bids Sept. 25, by Conway Corp., c/o E. V. Leverett, supt., furnishing, installing one 1,000 h.p. diesel engine and generator for electric plant. $70,000.

Conn., Westport—Door Co., Inc., Danbury Rd., plans by L. F. Caproni, 1221 Chapel St., New Haven, constructing 1 story, 80x170 ft., and 2 story, 30x170 ft., brick factory. $100,000.

Fla., Dania—Florida Power & Light Co., B. C. Hanks, pres., Ingraham Bldg., Miami, plans constructing 50x100 ft. generating plant, 88 ft. high, also installing 25,000 kw steam turbine generator. $3,000,000. Maturity soon. Private plans.

Ill., Chicago—Arvey Corp., 3462 North Kimball Ave., plans constructing factory addition, 135,000 sq. ft. floor space, Kimball Ave. and Addison St. $350,000.

Ill., Chicago—Wishnick-Tumpeer, Inc., 365 E. Illinois St., plans constructing factory, Merrimac Ave., 51st St. $150,000.

Ind., Decatur—Bd. P. Wks., F. Elzev, chn., City Hall, plans constructing power plant improvements, 5,000 kw. turbo-generator, 400 lb. pressure water tube boiler, switch-board, piping. $500,000. Froehlich & Emery, 410 2nd Natl. Bank, Toledo, O., consult. engrs.

Ia., Brooklyn—City, J. Schmitz, clk., plans election Sept. 22 to vote on construction light plant. $135,000.

Ia., Fort Madison—State Bd. Control, Des Moines, will build 54x240 ft. brick, steel power plant at State Penitentiary by own forces. $186,000. H. J. Liebbe, state archt.

Ia., Greenfield—Bids Oct. 3, by Town, C. L. Dowming, clk., constructing improvements to electric light plant, Diesel engine, 700 hp., complete with generator, exciter, etc. Over $25,000. Stanley Eng. Co., Muscatine, engrs.

Md., Baltimore—Western Maryland Dairy, Linden Ave. and Dolphin St., plans constructing dairy plant, Loch Raven Blvd. and Baltimore & Ohio R. R. $1,600,000. Private plans. Maturity this fall.

Mass., Wrentham—Commonwealth of Massachusetts, Dpt. Mental Health, Dr. C. T. Perkins, comr., 100 Nashua St., Boston, plans constructing power plant at State School. $63,500 appropriated. Architect not appointed.

Michigan—Consumers Power Co., D. E. Karn, vice-pres. and genl. mgr., 110 E. Michigan Ave., Lansing, plans installing 35,000 kw. turbo-generator unit in John O. Weadock steam electric station at mouth Saginaw River on Saginaw Bay, several new transmission lines, gas mains, and gas service improvements in various parts of state, addition of 20,000 kw. turbine units at Jackson, Battle Creek, Grand Rapids and Kalamazoo. $9,000,000.

Mich., Grayling—Bids Sept. 25, by G. A. Granger, city mgr., constructing 1 story, basement, 42x74 ft. diesel electric power plant building, foundation for generating equipment, etc. Ayres, Lewis, Norris & May, Ann Arbor, engrs.

Mich., Jackson—Goodyear Tire & Rubber Co., completed plans constructing power plant. $400,000. D. E. Sheahan, resident mgr.

Minn., Luverne—City, C. H. Hazzard, city clk., making plans furnishing, installing 600 kw. Diesel power generator in power plant; also 20,000 gal. fuel tank. $67,860.

Minn., Wheaton—M. J. Fridgan, village clk., plans constructing power house, generating equipment and distribution system. Over $40,000. G. M. Orr & Co., 542 Baker Arcade Bldg., Minneapolis, engrs.

Mont., Forsyth—City, H. V. Beeman, city clk., plans calling special election for constructing light and power plant. Over $60,000. F. F. Palmer, city engr.

Nebraska—Ak-Sar-Ben Public Power & Irrigation Dist., Ashland, making survey constructing power, irrigation, recreational, soil conservation, dam, flood control, buildings, cottages, landscaping, etc. $4,500,000. Ambursen Eng. Co., 295 Madison Ave., New York City, engrs.

N. Y., Brentwood—Bids Sept. 27, by State Dpt. Mental Hygiene, Albany, heating, electrical work, coal handling apparatus, additional power plant facilities at power house, Pilgrim State Hospital. $200,000. W. Haugaard, comr. Architecture, archt., and T. F. Farrell, ch. engr., both State Office Bldg., Albany.

N. Y., New York—Consolidated Edison Co., 4 Irving Pl., plans altering electric power plant, 1 Ave., 39 and 40 Sts., East River. $1,000,000. T. R. Galloway, c/o owners, engr.

N. D., Whitman—Five-Star Rural Electric Cooperative, E. A. Walker, secy., Whitman, plans constructing power house and generating plant. $40,000. Ellerbe & Co., 1021 E. 1st Natl. Bank Bldg., St. Paul, Minn., engrs.

O., Mansfield—Tappan Stove Co., Mansfield, soon takes bids constructing 1 story factory. $100,000 incl. equipment.

O., Toledo—City plans converting Broadway water pumping station into municipal electric and power plant. Petitions are being circulated for a public referendum on the proposal at the Nov. 9 election. W. W. Harris, dir. Pub. Serv.

Okla., Stillwater—City made sketches power plant enlargement, installation additional steam turbine. $75,000. G. H. Randleman, Stillwater, engr.

Ore., Roseburg—Gatewood Lumber & Plywood Co., Roseburg, Ore., E. E. Gatewood (incorporator), 2210-10 Ave. N. Seattle, Wash., plans constructing plywood plant and sawmill, 20 mi. south of here. $800,000.

Tex., Corpus Christi—Central Power & Light Co., L. Hill, pres., soon takes bids installing power plant on Nueces Bay in vicinity of main port area. $100,000. J. T. Pearsons, ch. staff owners and Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., engrs.

Tex., Harrisburg—A. S. Bergendahl, Bankers Mortgage Bldg., Houston, plans constructing iron smelting plant on ship channel. $500,000. A. S. Bergendahl, Bankers Mortgage Bldg., Houston, engr.

Tex., Raymondville—Evergreen Farms Co., W. W. Hardin, plans constructing dehydrating plant. $100,000.

Tex., Robstown—City, J. W. Kellam, mayor, soon takes bids installing engine generator set or unit for present municipal power plant, diesel or electric. $90,000. Garrett Eng. Co., 308 Hughes St., Houston, engrs.

Tex., Timpson—Bids Sept. 22, by City, c/o J. W. Kristensen, mayor, power plant improvements, furnishing, erecting 300 kw. Diesel generating equipment, addition and improvements to switchboard in electric generating plant. H. B. Gieb & Co., 1109 Mercantile Bldg., Dallas.

Tex., Winters—H. L. Speer, mayor, plans constructing municipal light and power plant, also distribution system. $80,000. Engineer selected soon.

Wis., Genoa—Tri-State Power Co., c/o secy., Genoa, plans constructing power plant and installing generating system to supply electric power to rural electric distribution lines in neighboring parts of Wisconsin, Iowa and Minnesota. Over $40,000.

Wis., Madison—Fauerbach Brewing Co., 651 Williamson St., plans by Balch & Lippert, 16 N. Carroll St., constructing bottling house. $175,000.

B. C., Vancouver—Boeing Aircraft Co. of Canada, Ltd., 1927 W. George St., soon takes bids constructing aircraft factory. $300,000. Private plans.

B. C., Victoria—Herculoude Aircraft of Canada, Ltd., M. E. Heiser, genl. mgr., Victoria, plans constructing aircraft factory. $150,000.

Man., Fort Garry—Manitoba Sugar Co., Ltd., Royal Bank Bldg., Winnipeg, plans constructing beet sugar refinery. $2,000,000. Subject to guarantee grant $600,000 from Provincial Government.

N. B., Bathurst—Bathurst Power & Paper Co., Ltd., A. J. Nesbit, genl mgr., 7 Main St., making plans constructing plant extension. $500,000. Maturity 1939. Engineer, c/o owner, engr.

N. B., Caraquet—Kenneth Campbell, archt., Fredericton, soon takes bids constructing fish processing plant, for Gorden Pew (New Brunswick), Ltd., Fredericton. $200,000.

Ont., Cochrane—Temiscaming & Northern Ontario Ry., S. B. Clements, ch. engr., North Bay, preparing plans constructing plant to handle 1,000 tons lignite daily. $500,000.

Ont., Frankford—Bata Import & Export Co., Ltd., Frankford, and 80 King St., Toronto, plans constructing 5 story, bsmnt., 60x260 ft. rein.-con. shoe factory, plain fdn., 1 mi. east of Frankford, near Hy. 33. $240,000. Private plans.

Ont., Kingston — Ontario Hydro Electric Comn., University Ave., Toronto, plans constructing hydro station. Private plans.

Ont., Fort William—Northland Terminal, Ltd., Fort William, H. E. Swift, acting pres., 303 Lombard Bldg., Winnipeg, Man., plans constructing grain elevator. $200,000.

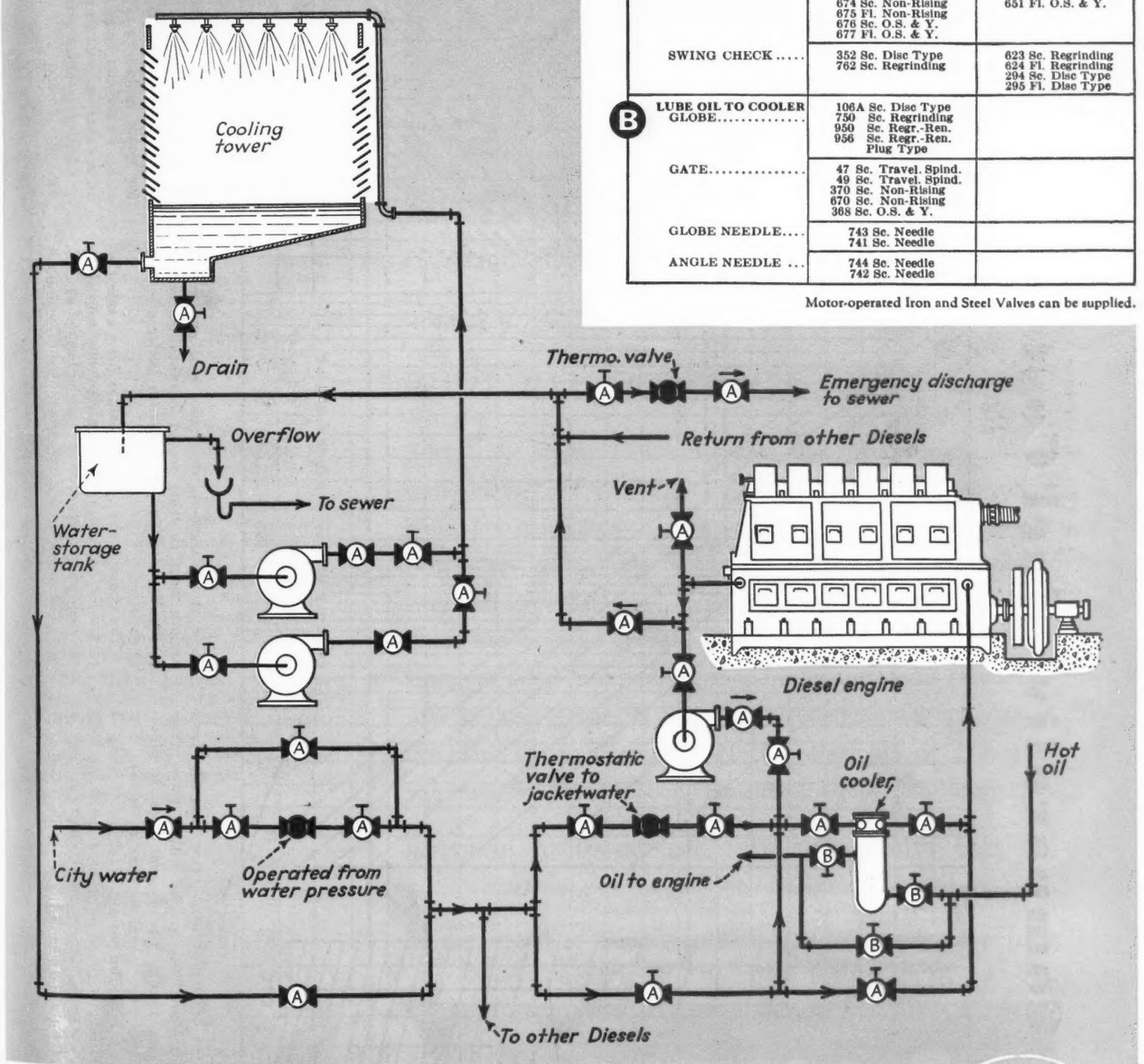
Ont., St. Catherines—American Distillery Co., Inc., 405 Lexington Ave., New York City, plans constructing distillery. $100,000. Site purchased.

Ont., Toronto — Ontario Hydro Electric Power Comn., 620 University Ave., soon takes bids constructing 110,000 volt substation, Toronto western outskirts, York Twp. $100,000. Reeve F. J. Mac Rae, West Toronto, interested. Private plans.

. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

COOLING TOWER



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		BRONZE	IRON
A	STORAGE TANK COOLING TOWER GATE	STANDARD 47 Sc. Travel.Spind 370 Sc. Non-Rising 368 Sc. O.S. & Y. 674 Sc. Non-Rising 675 Fl. Non-Rising 676 Sc. O.S. & Y. 677 Fl. O.S. & Y.	STANDARD 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
B	LUBE OIL TO COOLER GLOBE	106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr.-Ren. 956 Sc. Regr.-Ren. Plug Type	
	GATE	47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 370 Sc. Non-Rising 670 Sc. Non-Rising 368 Sc. O.S. & Y.	
	GLOBE NEEDLE	743 Sc. Needle 741 Sc. Needle	
	ANGLE NEEDLE	744 Sc. Needle 742 Sc. Needle	

Motor-operated Iron and Steel Valves can be supplied.

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

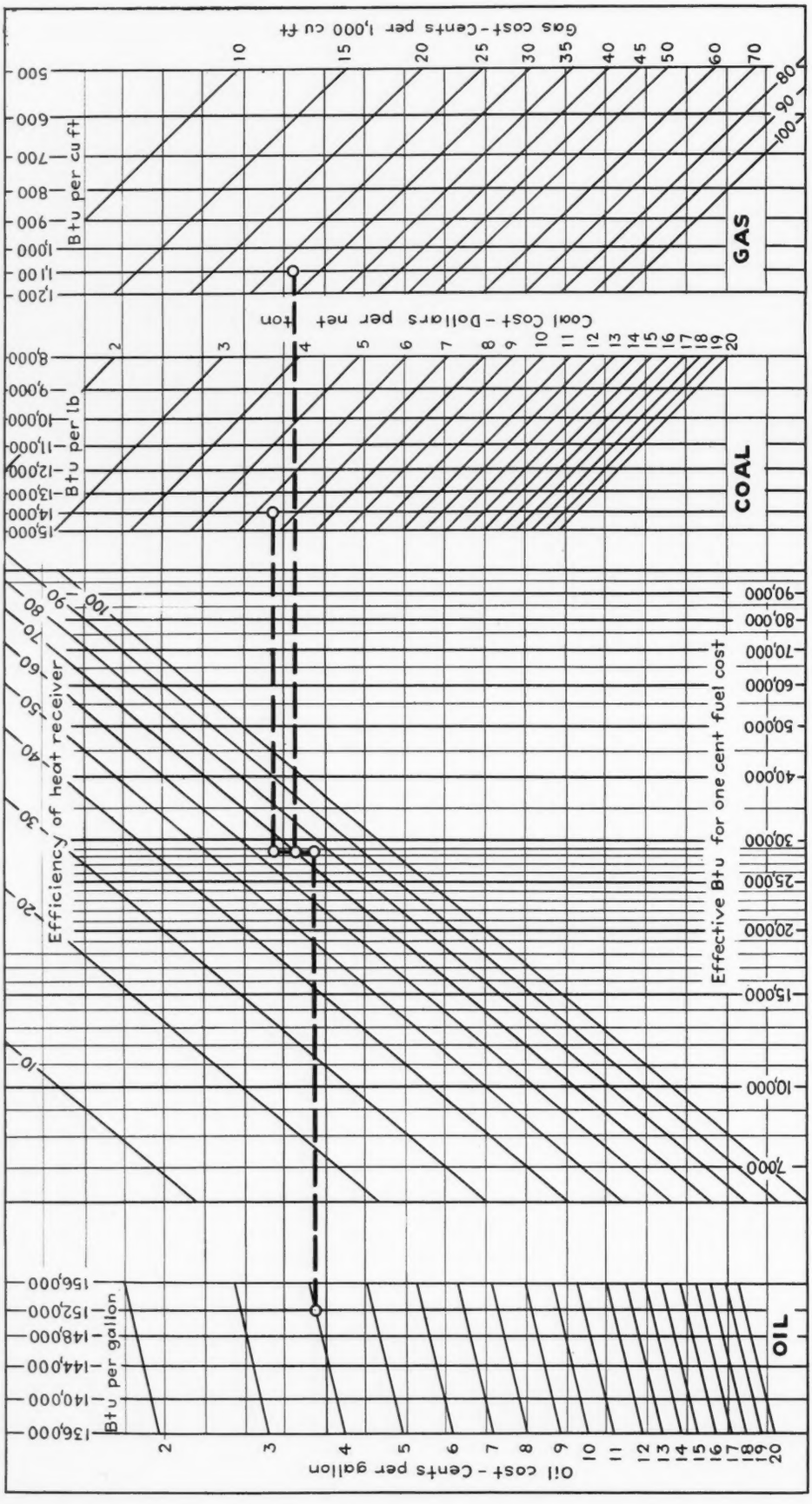
Bridgeport • Boston • Chicago — Philadelphia • Atlanta • Houston

1864—1939 DIAMOND ANNIVERSARY

#10 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 87

Comparative Fuel Costs, Oil-Coal-Gas


OIL
Oil cost - Cents per gallon
Btu per gallon
COAL
Coal Cost - Dollars per net ton
Btu per lb
GAS
Gas cost - Cents per 1,000 cu ft
Btu per cu ft
Efficiency of heat receiver
Effective Btu for one cent fuel cost

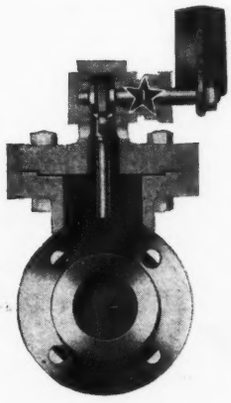
THIS CHART SHOWS at what price alternate fuels must be delivered to compete with a given price for any one, taking into account possible differences in efficiency of heat-recovery equipment. For example, 152,000-Btu-per-gal. fuel oil, costing 4 cents per gal., is to be used in a boiler of 75% efficiency. Starting with the oil chart at left, a horizontal line (not shown) across the page will show at a glance at what price coal and gas of various heat contents would have to be bought to break even if no difference in boiler efficiency is expected.

The chart in the center provides for a correction factor for difference in boiler efficiency caused by the fuel being burned. If gas can be burned at 70% and coal at only 65% efficiency, then the equivalent price of 14,000-Btu coal would have to be $6.40 per net ton and 1,100-Btu gas would have to sell at 27 cents per 1000 cu ft. The chart is intended for quick and accurate comparison of fuel cost alone, no account being taken of other factors such as installation, maintenance and so forth.

Adapted from an original copyrighted chart by Ray Oil Burner Co.

© POWER

The COPES "5-STAR" BALANCED VALVE



★1 The horizontal rotating lever shaft reduces friction to less than 2 pounds in the largest sizes, compared with from 6 to 16 pounds or more with a sliding stem.

★2 High valve lift, from $\frac{5}{8}$-inch on $\frac{3}{4}$-inch valves to $1\frac{3}{8}$ inches on 6-inch, permits more accurate control and increases the life of the inner valve parts.

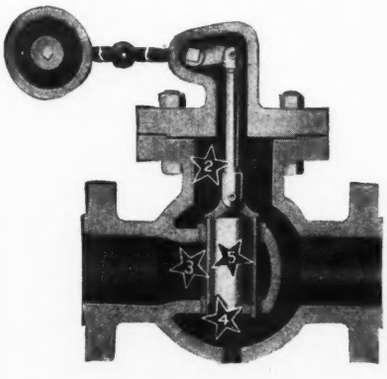
★3 Sleeve type or bevel-seating piston furnished as required by the operating conditions.

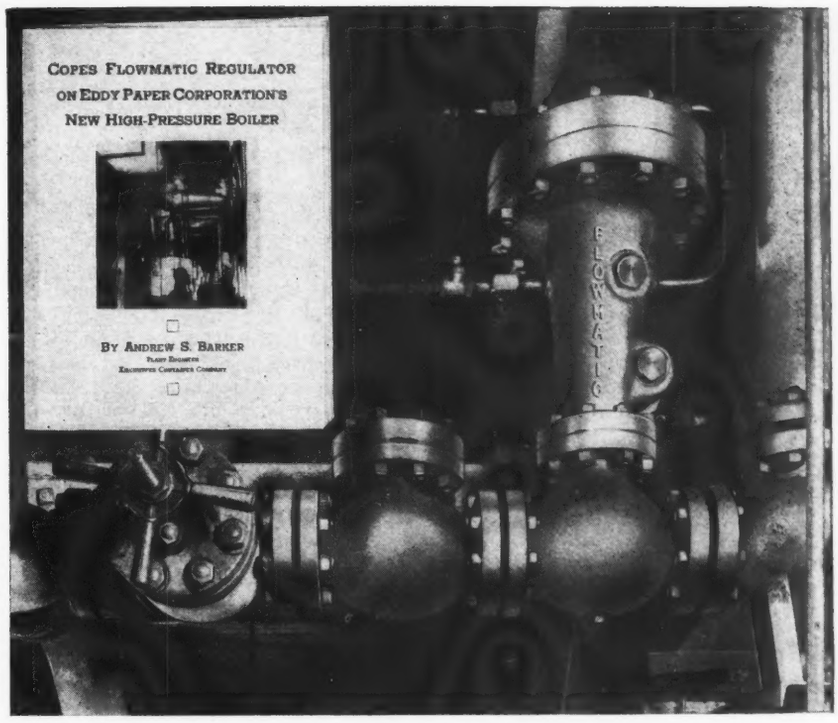
★4 Rectangular, "V" or compound ports are accurately designed for the operating conditions.

★5 Valve piston is scientifically balanced under flows and pressures, more so than any other make of "balanced" valve.

This "5-Star" Balanced Valve can be furnished for use with any actuating element. Or complete with solenoid, thrustor or motor for remote electrical control. Or with diaphragm operator for remote control by gas or air. For complete information—

Write for Control Catalog





FROM A REPORT ON THIS FLOWMATIC INSTALLATION:

"very stable boiler water level, with no more than routine care."

Add Eddy Paper Corporation to the fast-growing list of well-satisfied COPES Flowmatic users. On a 500-pound Badenhausen Steam Generator—average efficiency, 83 per cent—the Flowmatic feeds correctly for all loads and holds a very stable water level, with no more than routine care. There has been no operating or maintenance problem of any kind, no need to supplement the fully-automatic Flowmatic with any sort of manual control. For a complete description of this plant, write for Bulletin 421. For effective feed control for your modern boiler, specify the simplified COPES Flowmatic.

NORTHERN EQUIPMENT CO., 1011 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

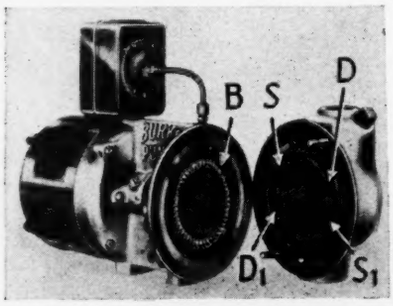
BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC REGULATOR

What's New In Plant Equipment

Turbine Pump

ORIGINALLY designed with a single inlet and outlet to and from the runner, Burks turbine pump is now built with two to give increased capacity with the same head. Curved buckets *B* are inserted in a groove in one side of bronze impeller between two rows of annular grooves, or sealing rings. These grooves match similar grooves



in the bronze suction and discharge plate. Between the two rows of grooves in suction and discharge plate a semi-circular channel extends from suction parts *S* and S_1 to discharge parts *D* and D_1. Matching of the grooves in the impeller and stationary element forms two sections of a closed raceway in which buckets accelerate fluid and discharge it at high pressure. Ball bearings on the rotor are so mounted that impeller's position can be adjusted to maintain close running clearance between annular grooves, to keep leakage at a minimum and compensate for any wear. These pumps will operate on suction lifts up to 28 ft at sea level and are made up to 25 gpm, for heads up to 230 ft (100 lb per sq in) and are used for pumping water, brine, alcohol, beer, light oil and many other similar free-running fluids.

Decatur Pump Co, Decatur, Ill.

Flange Unit

"SEALMASTER" flange unit claimed to be only self-aligning bearing unit with seals built as integral part of bearing proper,

independent of the housing. Misalignment cannot interfere with effectiveness of seal, according to manufacturer, for even though bearing is removed from housing, dirt cannot enter bearing.

Stephens-Adamson Mfg Co, Aurora, Ill.

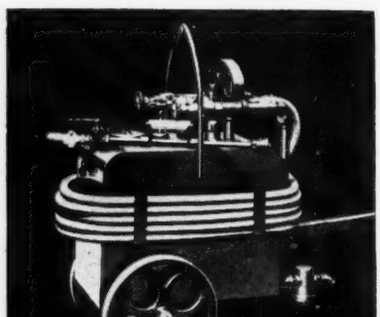
Welding Surface Powder

"SURFACEWELD 'A'" is fine-grained alloyed powder to be applied with carbon arc, and said to give smooth, dense, hard surface. When properly applied, will give coating with hardness of approximately Rockwell "C" 54, varying somewhat, depending on amount of admixture with base metal. Said to be extremely abrasion resistant and economical, due to fact that it can be applied in thin layers without losing quality.

Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio.

Arc Welder

"TRANSARC" welder has no electrical or mechanical connections between power lines and welding leads. Welder has range of 20 to 200 amp and is designed to operate on 220 v, single phase power lines. Unit is controlled by large ring, for dif-

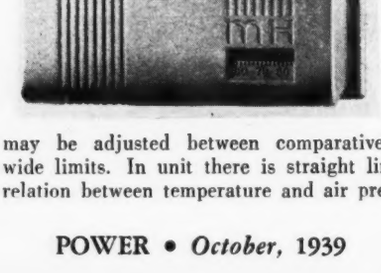


ferent welding ranges. Inner switch used to adjust to any arc condition or intermediate steps between outer ranges. Inner control can be used to disconnect welder from power source without pulling plug or shutting off regular line switch.

Hobart Bros Co, Box TA69, Troy, Ohio

Thermostat

"GRAD-U-STAT", available for either wall or duct mounting, has no leakport, and uses air only when changing position of an air motor or valve. Single model of unit can be used as direct- or reverse-acting thermostat and throttling range of differential



may be adjusted between comparatively wide limits. In unit there is straight line relation between temperature and air pressure in the branch line between 0 and 15 lb compared to usual curve of leak-type thermostat, which usually permits graduation between 3 and 13 lb.

Minneapolis-Honeywell Regulator Co, 2950 4th Ave South, Minneapolis, Minn.

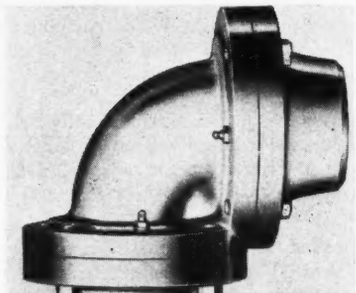
Motor Protector

"THERMOGUARD" protects against motor failures caused by continuous overloads, frequently repeated overloads, jamming of motor or drive, inability to start because of low voltage, inability to run because of low voltage, excessive temperature and lack of ventilation. Consists of snap-acting concave disks made of dissimilar materials with different coefficients of expansion enclosed within the motor. When rising temperature causes disks to snap into open position, 2 breaks are produced in series in motor circuit. Reclosing may be either fully automatic, manual, or automatic after definite time interval.

Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.

Steel Swing Joint

"CHAMPION", all-steel joints give 360 deg rotation in 1, 2, or 3 planes and can be used on fluid, gas, or steam lines, for all pressures up to 5000 lb. Low-pressure joints are drop-forged-steel castings, tested for 500 lb water pressure, and are leak-proof. Feature of both low- and high-pres-



sure joints is straight fluid course provided, which eliminates all abrupt shoulders. Inside diameter of every joint is the same as line with which it is used, and joints may be repacked without removing from line. All joints available in three different types, and in sizes from 2 to 8 in., for all applications.

H & B Sales Co, Ltd, 2875 Cherry Ave, Long Beach Calif.

Tension-Measuring Wrenches

SNAP-ON TORQOMETERS said to eliminate distortion, improve performance, and minimize wear. Pre-determined leverage measures deflection of solid steel bar, indicating

"TO THINK I'D O.K. A REQUISITION FOR A LOT OF SHOESTRINGS!"

That Was What One Paper Plant Superintendent Said Six Years Ago! But Today Texrope Drives Are Standard Equipment in His Plant . . . Providing Positive, Slipless Transmission . . . Saving Money Every Day! Read About Texrope Drives . . . Your Way to Lower Transmission Costs!

ONE OF TEN TEXROPE DRIVES IN A LARGE eastern paper plant, this 125 hp drive has been in continuous 24-hour operation since March, 1933, without any cost for replacements . . . is expected to go on giving 100% service for a long time to come!

The plant superintendent came in, took one look at workmen installing a Texrope Drive, and said—"To think I'd O.K. a requisition for a lot of shoestrings!"

That was six years ago in the plant of an eastern paper manufacturing company. And apparently the superintendent didn't think much of the first experimental lot of Texropes put on a beater in his plant.

But wait—read what happened next! They found that the "shoestrings" really stood up . . . even under the stress of 24-hour operation, day in and day out! Moreover, they found the Texrope Drive handled the beater as no other drive had ever done before—quietly, efficiently, with no slip or jerk, and not a penny spent for replacements!

That's why the superintendent now grins when he thinks of that day six years ago when he called them "shoestrings." For today Texropes are standard all through his plant. And every one of those original Texrope belts is still giving 24-hour a day service . . . beating transmission maintenance costs . . . making real savings!

You Save With Texrope!

Best of all — today, with new, important improvements, you get even better belt performance. For when you use Texropes, you get belts made with a new, special, cool-running rubber compound that gives longer life than ever before. What's more, they are sold in scientifically matched sets for equal pulling and long, even wearing.

To find out the power transmission savings that Texrope Drives bring you, get in touch with the nearest Allis-Chalmers district office or representative. Or write direct to Allis-Chalmers for money-saving facts.

A-1138

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

ALLIS-CHALMERS

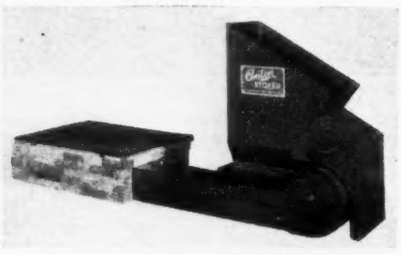
MILWAUKEE · WISCONSIN

such on dial, reading remaining constant. Tool comes in 6 sizes, for use in several industries. Scale measurements range from 0 to 1500 ft lbs. Dial can be set in advance to tension reading, and all nuts or bolts tightened until required tension is reached. Illustrated are wrenches for measuring from 0 to 600 ft lbs.

Snap-on Tools Corp, Kenosha, Wis.

Worm-Type Stokers

CANTON worm-type underfeed stokers has side ash dump plates installed in each side of the furnace. Sectionally built feed worm, to prevent warping, enables user to replace

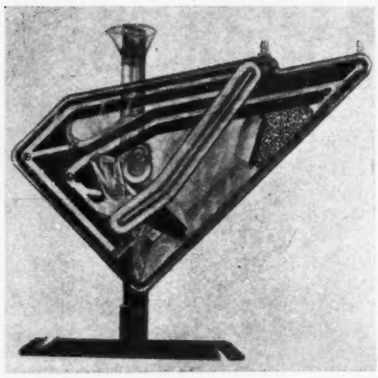


worn parts without replacing whole worm. Stoker may be internally cleaned without unnecessary dust and fumes.

Canton Stoker Corp, Andrew Place, S W, Canton, Ohio.

Automatic Flue-Gas Analyzer

"ORSATOMAT" employs principle of volumetric measurement and chemical absorption, done through use of mercury. In operation, operator pulls out small rod that protrudes from side of the case, aspirates gas into the unit by small rubber bulb, and pushes rod in. Percentage of CO_2 is shown on dial at front of case. As rod is pushed in it tilts pivoted unit causing a column of mercury to flow by gravity to push trapped gas sample into absorption chamber where CO_2 is instantly absorbed. This absorption causes sample to shrink, creating vacuum which works on sensitive metallic bellows connected to dial pointer.



Hays Corp, Michigan City, Ind.

Aluminum Paint

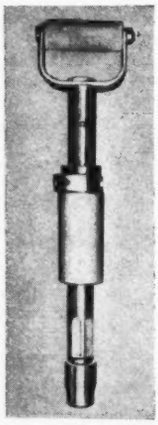
"FENCE-BOND" is ready-mixed aluminum paint made especially for painting rusted chain link or any other rusted surface, without removing rust. Base oils of paint are of penetrating type, creeping into all joints and contact points and sealing rust against further corrosive action. Pigment is Alcoa Albron paste mixed at factory.

Skybrite Co, Cleveland, Ohio.

Velocity Power Driver

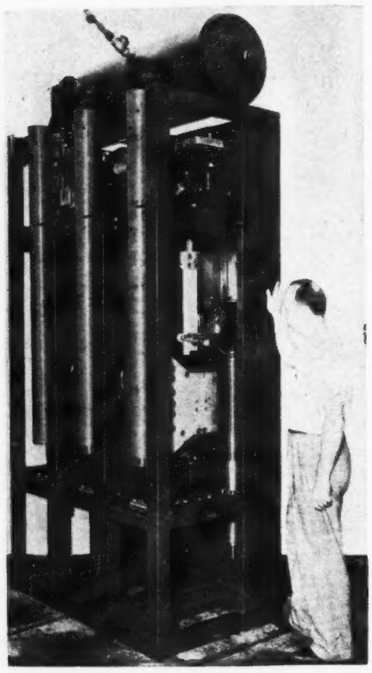
MSA PORTABLE POWER TOOLS operated by special blank cartridge fitted with threaded steel stud. Energy created by detonation of sealed charge of smokeless powder is utilized by tool. Will drive ½-in SAE threaded solid steel studs into structural steel plate from ⅜ to 1⅛ in. thick, and will drive ½-in. threaded hollow steel studs into structural steel plate from ⅜ to ⅝ in. thick, inclusive. When equipped with proper adapter, will punch holes in ⅜ and ½-in. structural steel plate, maximum diameter ⅝ in. Will also shear through rivet heads so that bodies can be removed. Operates under water to depths of 150 ft, as well as above water, and pre-loaded barrel assemblies may be inserted in firing unit under water as desired and needed.

Mine Safety Appliances Co, Braddock, Thomas & Meade Sts, Pittsburgh, Pa.



Air Circuit Breaker

"AIR BLAST", oilless-type circuit breaker, now made for 15,000-volt service with interrupting ratings from 500,000 to 1,500,000 kva. Air compressed at 150 lb is used to operate breaker as well as interrupt circuit. High-pressure air stream removes arc products through special air-blast



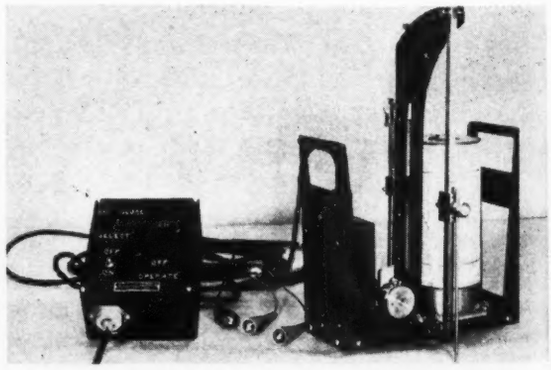
chamber and exhaust muffler, causing circuit to be interrupted at first current zero after contacts have been parted. Breaker has separate interrupting unit for each phase, operation of same is trip free at any point of closing stroke, and no latch is required to hold it in open position.

General Electric Co, Schenectady, N.Y.

Circuit-Breaker Analyzer

DESIGNED for oil circuit breakers, device consists of two main elements: vertical drum carrying ruled chart, driven by a synchronous motor through gear reducers, and pencil slider operated through reducing mechanism by the lift rod of oil breaker. Rotary motion of drum gives time in cycles as abscissa on chart, while ordinate represents travel of circuit-breaker contact mechanism.

Cincinnati Clock & Instrument Co, 1117 Horrison Ave, Cincinnati, Ohio.



REGISTERED PROFESSIONAL CHEMICAL ENGINEERS

CABLE ADDRESS BETZPHIL BENTLEY CODE

W. H. & L. D. Betz

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

GENERAL OFFICES AND LABORATORIES-235 W WYOMING AVENUE
PHILADELPHIA, PENNSYLVANIA

Gentlemen:

At the present time, the Betz Laboratories in Philadelphia and Chicago are making 34,000 Water Analyses Annually.

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Jas. K. O'Brien

P.S. Betz Service, Based on Facts - supplied by these analyses, offers you outstanding assistance on your water problems whether they may be scale, foaming, pitting, embrittlement or any other factors affecting steam quality or cost. Write. No obligation.

NEW YORK OFFICE-50 CHURCH STREET. - - - - CHICAGO OFFICE-37 W. VAN BUREN

Lubrication System

"LUBRIFLUSH" system of lubricating motor bearing eliminates lubricant. Through duct leading from outside of motor, new lubricant is injected to inner side of bearing with pressure gun. Drain is placed on opposite side of bearing underneath, and as new lubricant is injected, old lubricant is forced out. Before new lubricant reaches outlet, it must flush entire bearing. Outlet can be closed when new lubricant begins to show.

U. S. Electrical Motors, Inc, Los Angeles, Calif.

Gate Valves

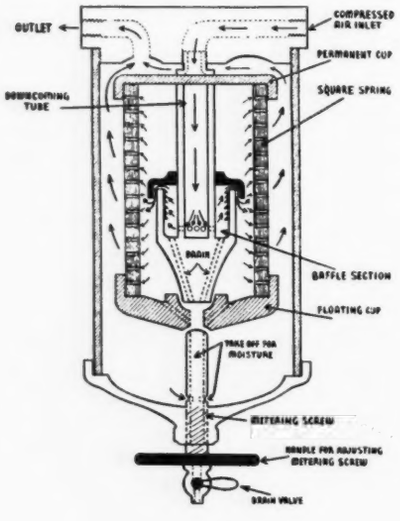
No. 422 AND 423, 200-lb brass valves are made with wedge disk, union bonnet and rising stem, and are identical except for body. No. 422 has seats cast integral with body, and No. 423 has renewable body seat rings. Valves are recommended for steam, water, oil or gas lines, in sizes of ¼, ⅜, ½, ¾, 1, 1¼, 1½, 2, 2½, and 3 in.

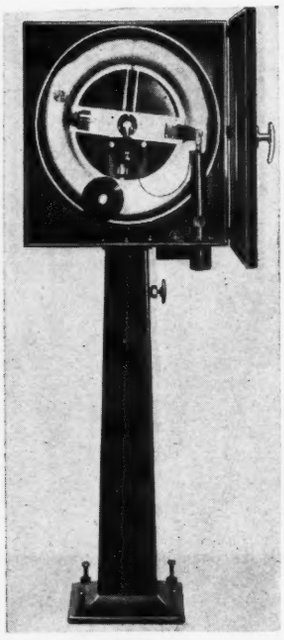
Crane Co, 836 S. Michigan Ave, Chicago.

Moisture Separator

"STEVENS", Model B-12, moisture separator provides positive filtration through correct design of baffling, together with edge-pressed coils of square spring. Area through coils regulated by metering screw, and ranges from .002 to .010 in. Capacity of unit is 120 cu fpm at 100 lb.

Master Metal Spray Co, 2527 Magnolia St, Oakland, Calif.





Ring-Balance Meter Body

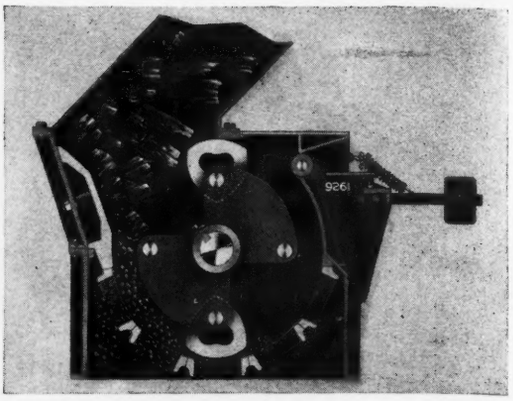
UNIT constructed to give full scale readings on differentials as low as 2 in. of water at static pressures up to 20 lb psi. Gas is confined to ring-balance and does not come in contact with measuring elements. Changeable calibrating device provided to change scale ranges. Differential pressure from primary element in gas line is impressed on a 22½-in. O D welding-steel tilting ring, causing it to move a standard resistance scale in a mercury well. This scale movement produces electrical resistance changes proportional to gas flow which actuate standard instruments, indicator, recorder, and integrator, at a remote point.

Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.

Warning Signal

"FILTER WATCHMAN" flashes light when excess dust load builds static pressure beyond danger point on air-conditioning filters or equipment. Accessory consists of dual metal disk 12 in. in diameter upon which is mounted housing containing the contact device which flashes lamp. It is attached by threaded nipple and locking nut at conditioner unit, and can be set for any predetermined pressure.

Simplex Controls, St. Louis, Mo.



Ring-Type Crusher

TRIANGULAR manganese steel sectors on crusher serve to minimize pulverizing of lumps. Unit cracks lumps instead of crushing them. Handles lumps of coal, peat, glass, limestone, steel turnings, salt, coke, gravel, etc, ranging in size from 6 to 26 in. Units available with or without apron fingers to remove unwanted materials.

Stephens-Adamson Mfg Co, Aurora, Ill.

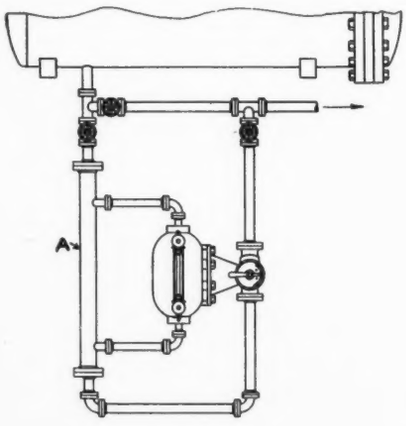
Cleaning Jet

"HI-PRESSURE" cleaning jet available in both portable and stationary models, can be used to clean pumps, machinery, coils, floors, etc. Heart of jet is mixing chamber, where water is admitted first. Then steam, which in process of condensation produces vacuum and draws in detergent, is forced into chamber, at the same time maintaining pressure in hose double that of initial steam pressure. From initial steam pressure of 25 to 100 lb jet pressure of 50 to 200 lb can be obtained. Equipment has 50 gal boiler plate solvent tank, and entire unit occupies space 18 by 30 in.

William Sellers & Co, Inc, Philadelphia.

Drainers

EXTERNAL cage-type drainers used for continuously removing large quantities of condensate under high pressures from heaters,



separators, coils or steam lines. In hookup illustrated, seal of condensate is carried in the drainer. As discharge increases from

(*Continued on page* 136)

Water Velocity?
Condenser Design?
Temperature?
Water Conditions?
Presence of Air?

Which condenser tube alloy is best for *your* combination of these variables?

THERE is such a complication of operating factors having an influence on the service life of condenser tubes that no one tube alloy can possibly solve all problems.

To determine the tube alloy that will give the greatest service per dollar of cost requires metallurgical experience and practical knowledge of specific operating conditions. So we suggest that you take advantage of the experience of our Technical and Engineering Departments. They can place before you performance records of copper alloys under operating conditions similar to your problem. No charge is made for such consultation. 39122

The following are the nominal compositions of Anaconda condenser tubes:

Alloy	Cu%	Ni%	Zn%	Al%	Sn%	As%
Super-Nickel 701	70	30	—	—	—	—
Cupro Nickel 712	80	20	—	—	—	—
Ambrac* 850	75	20	5	—	—	—
Ambraloy* 901	95	—	—	5	—	—
Ambraloy* 927 (Pat.)	76	—	21.95	2	—	0.05
Admiralty Alloy 442	70	—	29	—	1	—
Arsenical Admiralty 439	70	—	28.95	—	1	0.05
Red Brass 85%	85	—	15	—	—	—
Tobin Bronze* 452	60	—	39.25	—	0.75	—
Muntz Metal 65	60	—	40	—	—	—
Copper, Arsenical Deoxidized 108	99.63	—	(Phosphorus 0.02%)	—	—	0.35

*Trade-marks Reg. U.S. Pat. Off.

ANACONDA from mine to customer

Anaconda Condenser Tubes

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Subsidiary of Anaconda Copper Mining Company

Playin' Safe

SOME PEOPLE don't realize that their great dislike for new ideas and thinking is the real reason why they never get anything done. Remember the stranger who stopped for a drink at a tumble-down shack of a Georgia cracker? Making conversation, he said, "How's your cotton coming along?"

"Ain't got none, 'fraid of boll weevils."

"Well, how's your corn?"

"Didn't plant none, 'fraid there mightn't be rain."

"Well, how're your potatoes?"

"Ain't got none, 'scairt of potato bugs."

By this time, the stranger was beginning to see the light. "Well, what did you plant?" he asked.

"Nothin'; I'm just playin' safe."

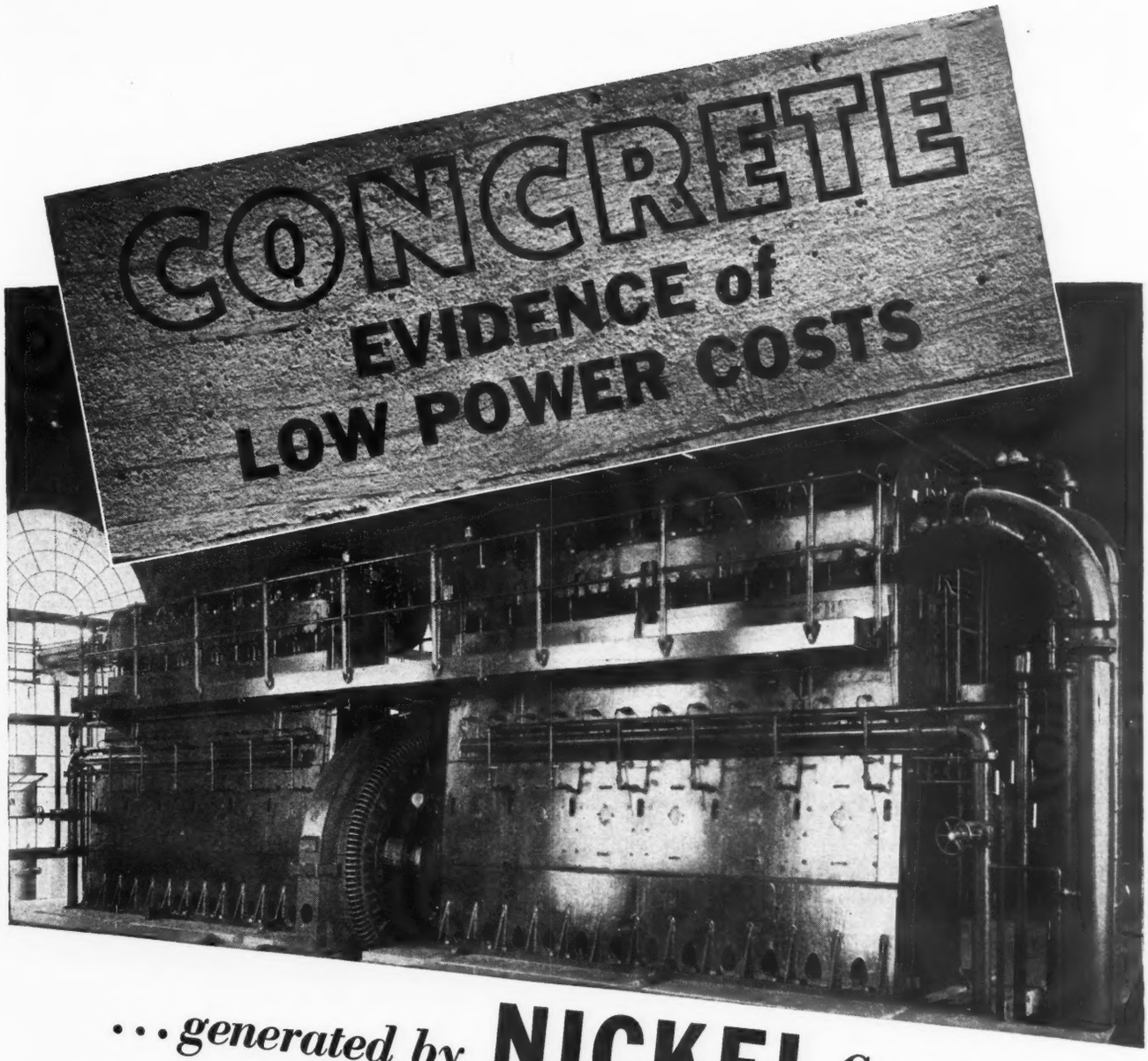
That picture isn't as haywire as it looks. Plenty of times it's easier to be "scairt" than it is to think a thing through. You've met the engineer who says: "My plant is good enough. Boilers are only 30 years old and engines 25. Power costs me 2.6 cents a kwhr at the switchboard, but nobody's kicked so far. Probably could save a little, but I'm afraid I couldn't get the money anyhow."

But someday, somebody does kick, or the plant falls apart like a one-hoss shay. Then it's too late. You can't mend a roof after it starts raining. The funny thing about the whole business is that it's a lot easier in the long run to do the little things as soon as you see 'em, because then there aren't so many big things to do. (The article on the John R Evans plant in last month's "Operating Engineer" is a good example.) Then, when you need something, if your figures check out to show that you do and the boss knows you're up on your toes, he'll be a lot more inclined to listen. To my mind, it's better to get rid of obsolete equipment than it is to play safe and end up by being obsolete yourself.

George Edwards

Engineer

"Between the great things we cannot do
and the small things we will not do,
the great danger is that we shall do nothing."
.....Adolph Monad



...generated by NICKEL *Cast Irons*

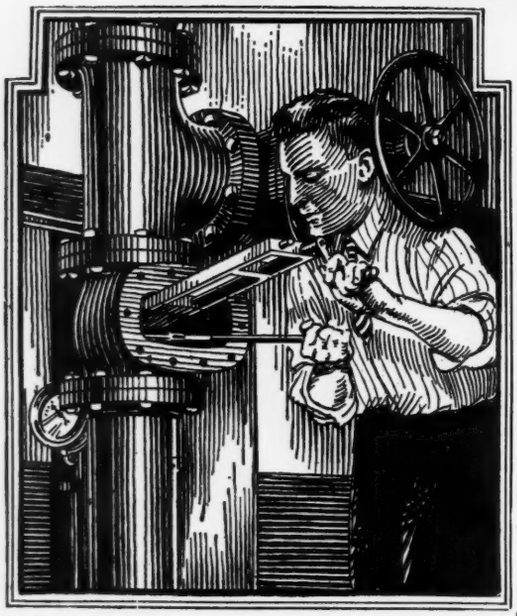
IN A Texas cement plant, where costs are figured to the fifth decimal place, this giant Diesel is the prime mover. Built by the Rathbun-Jones Engineering Co., Toledo, this 12-cylinder engine, with its 19½" bore and 28" stroke, generates 2150 HP. Ensuring longer, trouble-free service, cylinder liners, valve cams and cam shaft sprockets were cast from a dense-grained iron containing 1.30% Nickel and 0.80% chromium.

TEXANS like 'em big—and tough. So these 19½" x 28" cylinder liners were cast from a Nickel iron. Adding Nickel induces tighter grain structure which produces a mirror-smooth wearing surface. Thermally stable, Nickel cast irons resist growth, maintain power-saving close clearances. Rathbun-Jones reports these Nickel cast irons showed a tensile strength of 31,700 p.s.i. For ultimate economy remember to specify cast irons strengthened and toughened with Nickel.

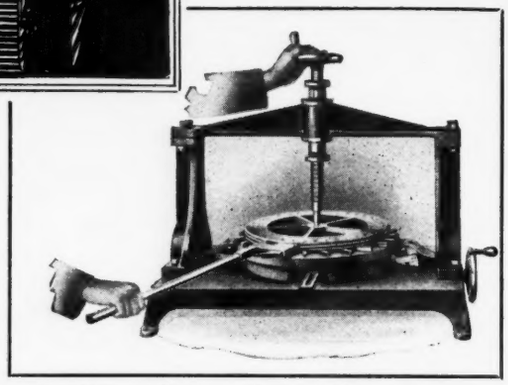
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

NOW you can keep your High Pressure Valves Tight

WITH DEXTER VALVE RESEATERS



INVESTIGATE THE NEW DEXTER LAPPING DEVICE *for* **HARD METAL TRIMMED GLOBE and GATE VALVES**



IF yours is a high pressure plant with hard metal trimmed valves—YOU NEED THE NEW DEXTER EQUIPMENT for reseating your valves.

With this outstanding development, facilities for refacing seats and gates exactly alike are provided which insure the handling of the job quickly, easily and effectively.

Stop leaks before they stop you. Ask for complete information on DEXTER VALVE RESEATING MACHINES,—the equipment which pays for itself over and over again and vastly reduces the necessity for costly replacement. Write TODAY.

(Also manufacturers of the Swendeman Separators which keep your compressed air lines oil- and water-free. Ask for new catalogue . . . just off the press)

THE LEAVITT MACHINE CO.

10 EAST RIVER ST. ORANGE, MASS.

Canadian Distributors:—

The Canadian Fairbanks-Morse Company Limited

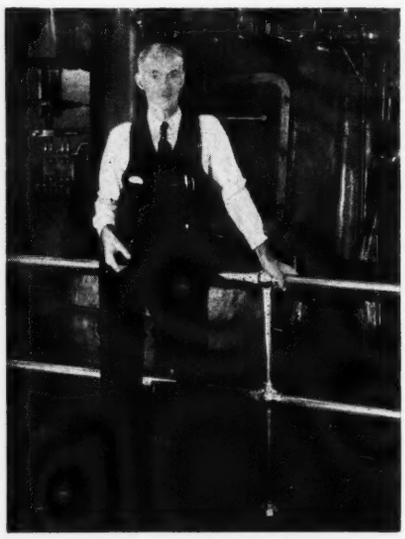
15 Branches Throughout Canada

An Editor's Northwest Passage

(*Continued from page 67*)

laundry with all the latest machinery for washing, extracting, untangling, drying, ironing, etc. He generates all his own power, using steam engines (picture story later).

Douglas Robertson, general manager of the Vancouver office of Canadian G E Co. takes me to lunch at the Vancouver Club. He serves a great territory of widely separated prospects—lumber mills, mines, canneries, etc.



Chief Frank Hull manages power for Vancouver General Hospital

Robertson confirms my impression that the Pacific Northwest from Seattle to Alaska is probably the finest green country, all things considered, on this continent—certainly the finest for salt-water scenery, cruising, fishing and hunting.

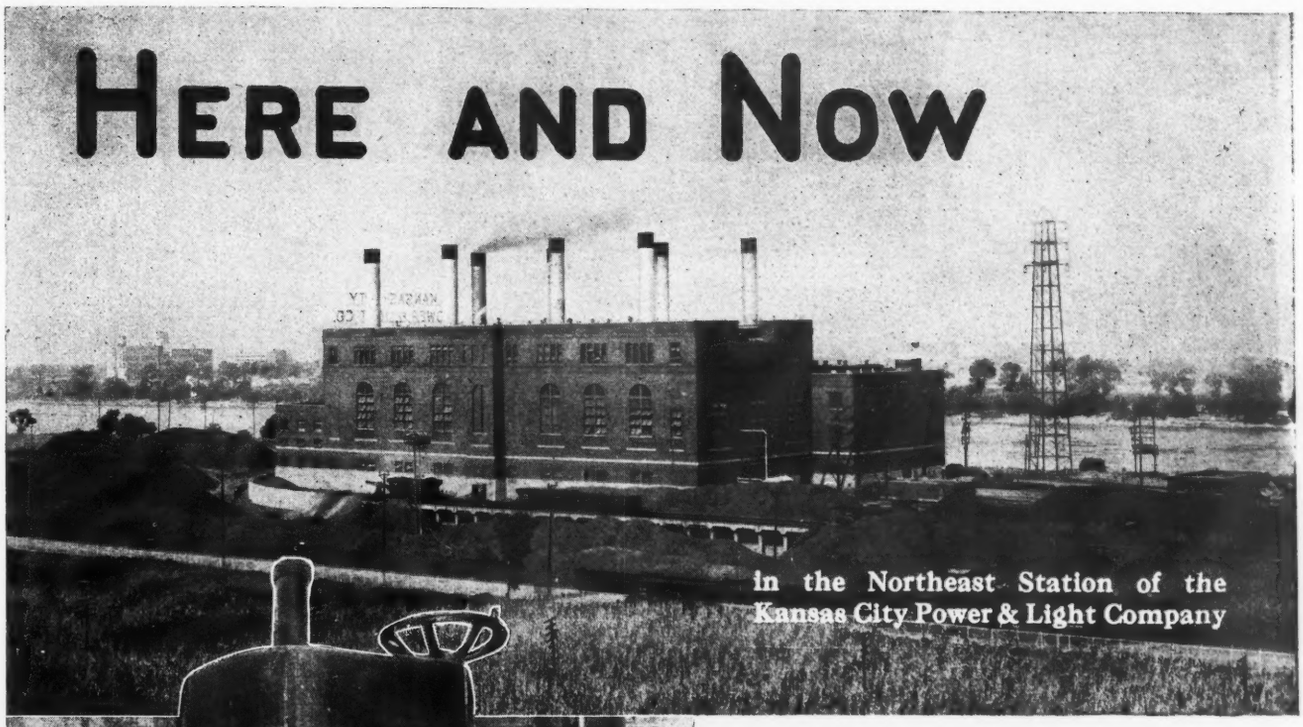
The Leg Home

From Vancouver, after a brief stop at Lake Louise and Banff, I ran straight across Canada to Montreal, then South to New York—"back to work" as my friends here like to put it.

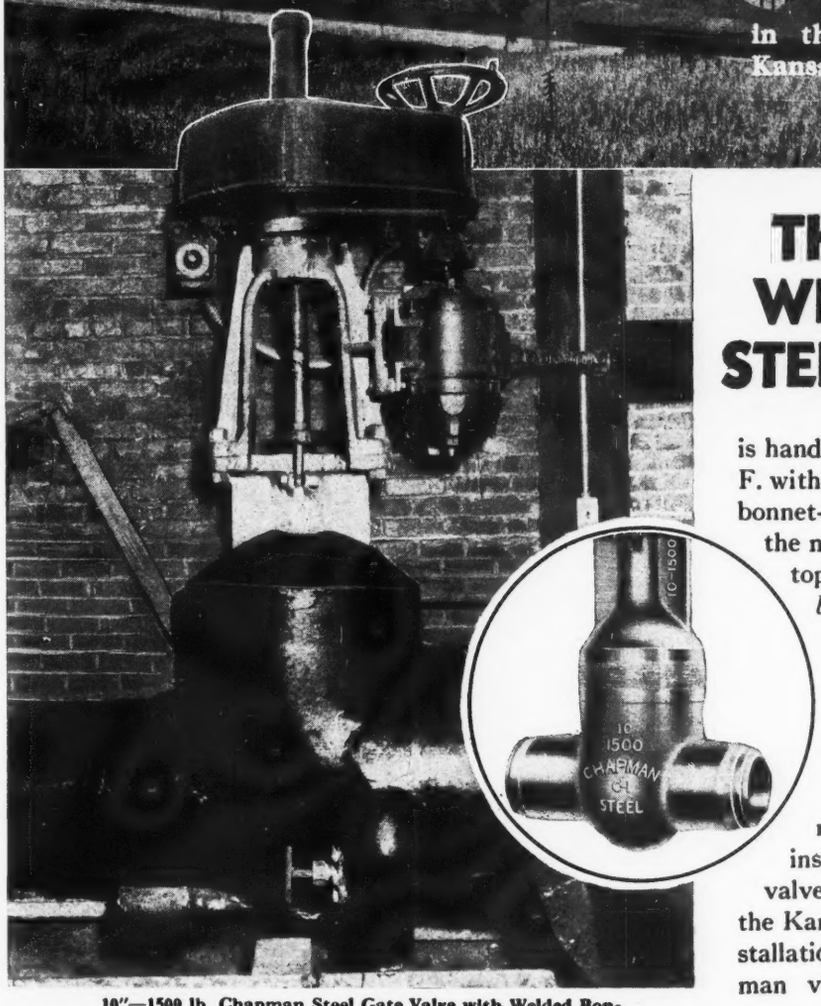
As I look back, these selections from my diary have been a bit long on scenery and short on engineering. Not so my private notes, which totaled around 35,000 words when I reached home. In them are many technical details for later publication in special articles, many of which will deal with gas engines, oil and gas burning, and hog fuel.

More important, perhaps, are new contacts made with Western engineers who are doing things and going places. From them will come practical ideas on design and operation. POWER has always been a national and international forum for the exchange of engineering ideas, but we have needed a little more from the pioneering West—and now, I think, we shall have it—PHIL SWAIN

HERE AND NOW



in the Northeast Station of the Kansas City Power & Light Company



10"—1500 lb. Chapman Steel Gate Valve with Welded Bonnet and Chapman Motor Unit, as installed in the Northeast Station, Kansas City Power & Light Co. (Inset) Typical Bonnet Weld and Welding Ends.

THIS CHAPMAN WELDED BONNET STEEL GATE VALVE

is handling 1275 pound steam at 825 degrees F. with positive assurance against leaks in the bonnet-body joint. The valve is installed in the main steam lead to the new 15000 KW topping turbine—a spot where only the *best* is adequate, and no weaklings allowed. A notable feature is the welding of bonnet to body, one end of which is welded to the line, the other end being flanged. Chapman is specially equipped for production of valves with these large welds, and radiographic examination of welds to insure their quality. Scores of Chapman valves are installed in the various lines of the Kansas City Power & Light Co. This installation is evidence of confidence in Chapman valve equipment, inspired by many years of satisfactory service.

THE CHAPMAN VALVE

MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

Insist upon the welding fittings that alone combine these eight features.

TAYLOR FORGE
★WeldELLS
Seamless Pipe Fittings for Welding
★ Trade Mark Registered

TAYLOR FORGE & PIPE WORKS
General Offices and Works: Chicago, P. O. Box 485
New York Office: 50 Church Street

1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

Power Lines

(Continued from page 118)

M L Erlenmeyer, Elmira, N. Y. distributor in and around Elmira. Boyer-Campbell Co, Detroit, Mich., Detroit distributor; and Berger Bros Electric Motors, Inc, Rochester, N. Y., distributor.

Morris Machine Works, Baldwinsville, N. Y., announces appointment of M H Morris as president; J L Lonergan, vice-president and general manager; A G Forssell, 2nd vice-president; and R S Mercer, secretary and treasurer.

D W Haering & Co, Chicago, Ill., announce removal of company offices to plant at 2308 S Winchester Ave, where more space has been provided for the increased personnel. Laboratory will be retained at 3408 W Monroe St in Chicago. Recent additions and changes in personnel include appointment of Chas W Bourne in charge of Virginia territory with offices at 725 W Main St, Richmond, Va.; R E McConighen in charge of Wisconsin Territory operating from 124 W Brown St, Milwaukee, Wis., and John A Coleman in charge of Dallas area, with offices at 4104 Stanhope Ave, Dallas, Tex.

General Electric Co, Schenectady, N. Y., has appointed G R Prout and W T Darcy manager of sales of industrial control and manager of sales of renewal parts, respectively. Mr Prout was formerly manager of the southwestern district for the company's industrial dept, and has been with General Electric since 1923. Mr Darcy joined the company in 1925 and has been in the Schenectady plant since 1934. Manly E Lord has been appointed manager of Fort Wayne works, succeeding Neil Currie, Jr, who will become assistant to the vice-president.

Warren Webster & Co, Camden, N. J. announce appointment of Darby Corp, Kansas City, Kan., as representatives in

Meetings

American Gas Association—*Annual Convention, October 9–12, Hotel Pennsylvania, New York, N. Y. Headquarters office, 420 Lexington Ave, New York, N. Y.*

American Society of Heating & Ventilating Engineers—*Annual Meeting in conjunction with 6th International Heating & Ventilating Exposition, January 22–26, 1940, Lakeside Hall, Cleveland, Ohio. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers—*Annual Meeting, December 4–8, Philadelphia, Pa. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*35th Annual Meeting, January 16–18, 1940, Blackstone Hotel, Chicago, Ill. David L Fiske, secretary, 37 W 39th St, New York, N. Y.*

Eastern Air-Conditioning Conference—*November 10–11, Lehigh University, Bethlehem, Pa. ASRE cooperating; write David L Fiske, ASRE secretary, 37 W 39th St, New York, N. Y., for details.*

Fuels Division, ASME, and Coal Division, AIMME—*Joint Meeting, October 5–7, Deshler-Wallick Hotel, Columbus, Ohio. R A Sherman, chairman, Battelle Memorial Institute, Columbus, Ohio.*

Refrigeration Service Engineers Society—*Annual Convention, January 15–18, Chicago, Ill. H T McDermott, secretary, 433 N Waller Ave, Chicago, Ill.*

NEW "RPM" DELO

[Diesel Engine Lubricating Oil]

Cuts Fuel Consumption and Exhaust Temperatures

IN FULTON DIESEL TEST

Let this thousand-horsepower engine drive home the story of one of the finest lubrication performance tests ever made in the Fulton Diesel Engine shops—

For the first 50 hours New "RPM" DELO was used to "run-in" the Fulton Diesel's brand-new pistons, rings and liners to a still smoother "mirror finish". Result—longer, full-power engine life from the start. Then the real performance test! Of course no rings were stuck—bearings were free from any sign of corrosion or wear—filters came through clean and unclogged.

BUT MORE! *Fuel consumption and exhaust temperatures were lower than ever recorded on any engine test in the Fulton shops!* Reduced operating costs! Higher engine efficiency!

Naturally, after its great performance test, New "RPM" DELO is recommended for Fulton Diesel Engines. Try it in your own equipment, regardless of size, type or make. You'll profit by it!

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

ORDER FROM YOUR NEAREST DISTRIBUTOR AS LISTED BELOW:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" Diesel Engine Lubricating Oil:
The Carter Oil Company
Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company
(Inc. in Kentucky)

Signal "RPM" Diesel Engine Lubricating Oil:
Signal Oil Company

Sohio "RPM" Diesel Engine Lubricating Oil:
The Standard Oil Company (Ohio)

IN CANADA AND NEWFOUNDLAND

New Imperial "RPM" Diesel Engine Lubricating Oil:
Imperial Oil Limited

IN BRITISH COLUMBIA, ALBERTA & SASKATCHEWAN

New "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD
"RPM" Diesel Engine Lubricating Oil is available through distributors in more than 100 countries.

RPM
REG. TRADE MARK
DIESEL ENGINE LUBRICATING OIL

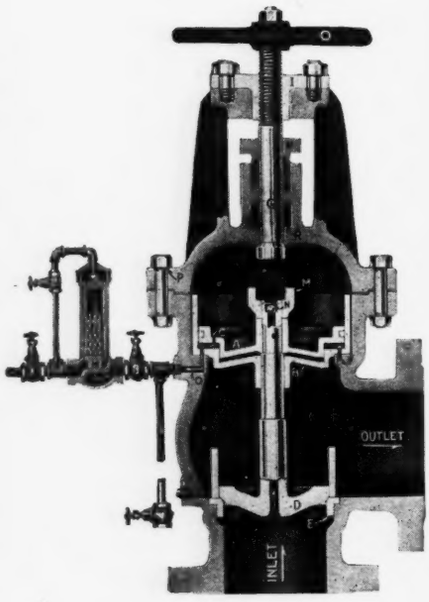
Unequaled
FOR EVERY DIESEL

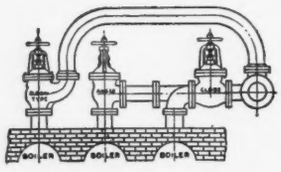
STANDARD OIL COMPANY OF CALIFORNIA

Golden Anderson

SPECIALTY

VALVES





TRIPLE-ACTING NON-RETURN

Make *safety* in your boiler plant a certainty with G-A's triple-acting non-return valve. No boiler explosions or bursting steam lines to damage life and property when you use this double cushioned valve that will not stick or chatter. Test it under pressure. With either flanged ends or welding necks, it handles 150 lbs. to 1500 lbs. The heaviest valves of this kind made, it comes in angle, globe or elbow types from 2½" to 16" in size.

Free catalog of complete G-A line sent to you on request. Write today.

also

Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check . . . and other types of valves.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. PITTSBURGH, PA.

Kansas, Oklahoma and Nebraska, as well as western Missouri, and part of southwest Iowa.

RILEY STOKER CORP, Worcester, Mass., announces opening of Chicago office, to be located in the Marquette Bldg. This office will be in charge of A L Mitchell, Jr, district manager, and T R Halstead, assistant district manager.

ALLIS-CHALMERS MFG CO's district office at Chattanooga, Tenn., has been moved. New address is the Chattanooga Bank Bldg, 737 Market St. D S Kerr is manager of this office. New branch offices have been established in U S Trust Bldg at Louisville, Ky., and LaPorte, Ind. W E Kercheval will be in charge of Louisville office, while B L Margeson will operate the LaPorte office. A B Frost has been appointed branch manager at New Haven, Conn., office, succeeding E D Hill, who resigned because of illness.

UNION CARBIDE & CHEMICAL CORP, 30 E 42d St, New York, N. Y., has announced the acquisition of the assets of the Bakelite Corp, which has its offices at 247 Park Ave. New York, N. Y. Financial arrangements have been concluded for the transfer of stock by stockholders.

RIC-WIL CO, Union Commerce Bldg, Cleveland, Ohio, announces retirement of Harry W Tucker as treasurer and eastern sales manager. Mr Tucker's interest in the company was purchased by C Gottwald & Associates. Management of company remains otherwise unchanged and New York office will continue to be maintained.

NORFOLK & WESTERN RAILWAY CO. Roanoke, Va., announces appointment of F S Baird, general coal freight agent, succeeding G C Van Zandt, retired.

NATIONAL ASSOCIATION OF POWER ENGINEERS has elected Lenhard W Thiele of Buffalo, national state deputy for the State of New York.

CHAIN BELT CO, Milwaukee, Wis. has acquired the business and assets of Baldwin-Duckworth Chain Corp, Springfield, Mass. The plants at Springfield and Worcester, Mass., will be known as Baldwin-Duckworth Div of Chain Belt Co. George H Empsall, Frank J Weschler, and George D Gilbert, former directors of the Baldwin-Duckworth Co, will continue as directors of the Chain Belt Co.

New Equipment

(*Continued from page* 128)

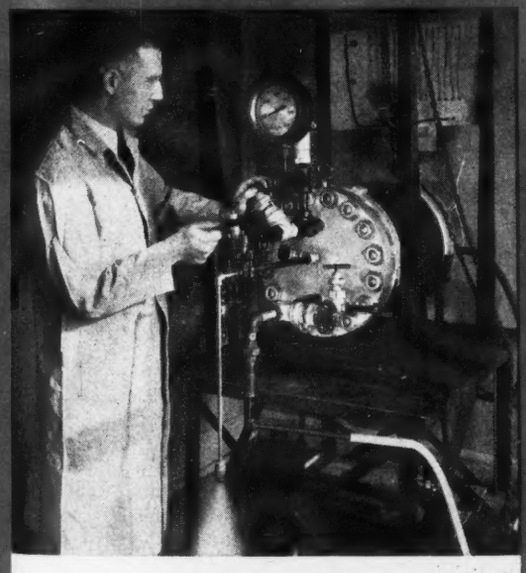
heater, level will rise in pipe *A*, causing drainer float to rise, opening drainer valve to accomodate greater rate of discharge required.

Cochrane Corp, 17th & Allegheny Ave, Philadelphia, Pa.

Gyroscopic Meter

"GYROMETER" utilizes force developed from a Gyroscopic couple and is available as a device for integrating flow of any

Prevent steam contamination – the DEARBORN WAY



Experimental Boiler in the Dearborn Laboratories

In this miniature high pressure boiler, Dearborn research engineers can duplicate conditions encountered in large power boilers. Thus, by constantly experimenting with new methods, Dearborn is able to offer the most advanced scientific treatment for the prevention of scale, corrosion, and steam contamination.

Every engineer knows that steam contamination in his plant means eroded and encrusted turbine blades, fouled superheater tubes, clogged up valves, scored cylinder walls, and other crippled equipment. You can prevent these troubles in your plant with Dearborn Treatment and a systematic blowdown schedule based on Dearborn recommendations.

Dearborn Treatment is also balanced to give full protection against scale and corrosion. It not only prevents new scale from forming, but gradually disintegrates any scale already present, while the boilers continue in service.

Dearborn engineers will make a thorough analysis of your plant, furnish a treatment balanced to fit your individual needs, advise you on blowdown, and check up frequently to see that you are getting satisfactory boiler operation.

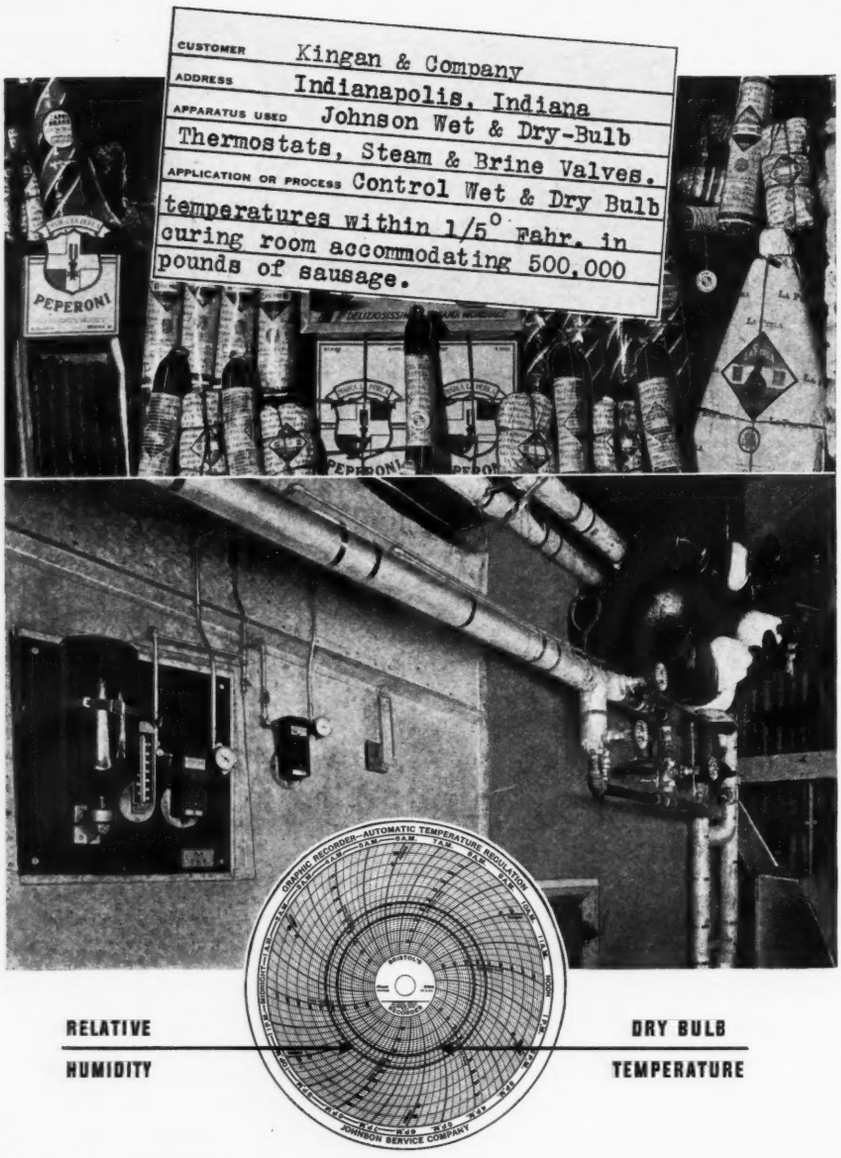
In thousands of plants, large and small, Dearborn Scientific Water Treatment is saving large sums by protecting boilers from scale and corrosion and by preventing undue steam contamination. See your Dearborn representative. Dearborn Chemical Company, Dept. D, 310 S. Michigan Ave., Chicago, Ill.

Dearborn

TRADE MARK REGISTERED

SCIENTIFIC WATER TREATMENT

CHICAGO • NEW YORK • LOS ANGELES • TORONTO and PRINCIPAL CITIES


CUSTOMER Kingan & Company
ADDRESS Indianapolis, Indiana
APPARATUS USED Johnson Wet & Dry-Bulb Thermostats, Steam & Brine Valves.
APPLICATION OR PROCESS Control Wet & Dry Bulb temperatures within 1/5° Fahr. in curing room accommodating 500,000 pounds of sausage.
PEPERONI
GRAPHIC RECORDER—AUTOMATIC TEMPERATURE REGULATION
JOHNSON SERVICE COMPANY
RELATIVE HUMIDITY
DRY BULB TEMPERATURE

The Problem:
EXACT CONDITIONS IN CURING ROOM

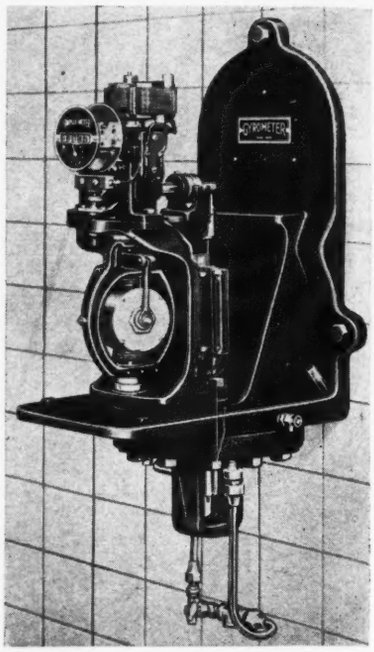
The Answer:
JOHNSON AUTOMATIC CONTROL

Special problems in exact control of temperatures and humidities for manufacturing processes is "regular business" for Johnson engineers. Manufacturers, all over the continent, turn to the Johnson staff of trained automatic control experts for the correct answer. Another case in point is Johnson wet and dry-bulb control in Kingan's sausage curing room. The chart, made by the recording instrument which checks this Johnson installation, speaks for itself. . . . For the control of space heating and air conditioning, too, Johnson apparatus is used in both plant and office sections of many industrial establishments, and in countless other types of buildings.

Call a Johnson engineer. There is no obligation.

JOHNSON SERVICE COMPANY

MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN PRINCIPAL CITIES

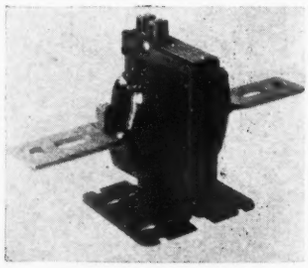


fluid, whether liquid or gaseous, in any size pipe or main containing either Venturi tube, Nozzle, orifice, or Pilot tube. Unit is arranged for wall or bracket mounting.

Simplex Valve & Meter Co, 68th and Upland Sts, Philadelphia, Pa.

Transformers

INDOOR dry-type current transformers are rated at 200 and 400 amp, 600 v, and 600 amp, 600 v, and designed with standards of Edison Electric Institute. Will withstand 150% normal current, they also have strength aganist instantaneous over-current. On 200 and 400-amp unit, mechanically



250 times normal current is guaranteed by makers, while thermally, windings will stand 80 times normal current for one second. On 600-amp unit, there is said to be no practical mechanical limit. Thermally the windings will withstand 100 times normal current for one second.

Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.

Automatic Air Valves

"AIRLINER" adjustable venting automatic air and vacuum valve for steam systems, provide advantages of 2-pipe system to ordinary 1-pipe gravity system. When system is "fired up" unit removes air from

(Continued on page 142)

LUNKENHEIMER
Fig. 1640
'KING-CLIP'

"THE KING OF CLIP VALVES"

Fig. 1640 is the original clip valve with drain channels and bronze thread bushing in bonnet.

The exterior construction clearly indicates the large drain channels; of ample size to thoroughly drain the bonnet of even fluids which tend to clog.

The bronze thread bushing cast in the bonnet has excellent wearing qualities and provides non-corrodible contact for stem.

Fig. 1640 "King-Clip" also has other important features:-

Bronze stem – perfectly aligned, with repacking seat above threads.

Extra strong stuffing box with hexagon head gland.

Bronze disc and rolled-in bronze seat rings – bronze to bronze contacts throughout which prevent corrosion.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI, OHIO, U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

CARRIED IN STOCK BY LUNKENHEIMER DISTRIBUTORS

5-83-42

"PALMETTO"

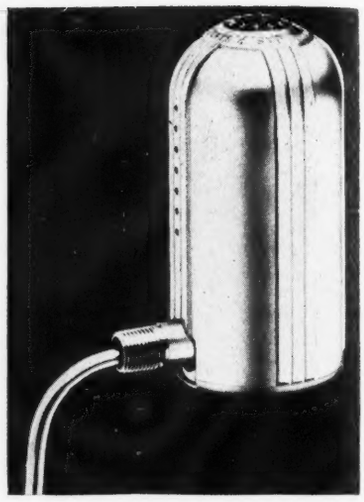
THE PACKING
for
Boiler Room Requirements

Auxiliary Engines and Pumps • Stokers • Soot Blowers
Valve Stems • Heater Valves, etc.

DOES NOT GET HARD
EASY TO INSTALL — EASY TO REMOVE

Send for Testing Sample • No Obligation • State Size

GREENE, TWEED & CO.
Sole Manufacturers 101 Park Ave., New York, N. Y.



radiators and closes when steam reaches it. When steam condenses, creating vacuum, unit seals radiators and holds vacuum. This causes the low-pressure steam or vapor to continue to circulate throughout the heating system, thus utilizing all heat from boiler when fire is to low to produce steam pressure.

Jas P Marsh Corp, 2073 Southport Ave, Chicago, Ill.

Heat-Resisting Coatings

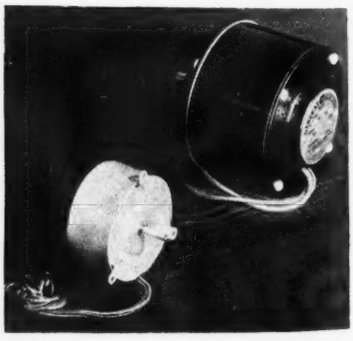
"THUR-MA-LOX" heat-resisting coating protects metal over a range of temperatures from ordinary conditions to 1800 F, depending on type used. Coatings are produced in black or aluminum and are composed of specially prepared pigments, to which aluminum paste is added for the aluminum coating. May be applied by brush or spray, and all are claimed resistant to corrosion and wear.

Thurmalox Co, 3109 N Broad St, Philadelphia, Pa.

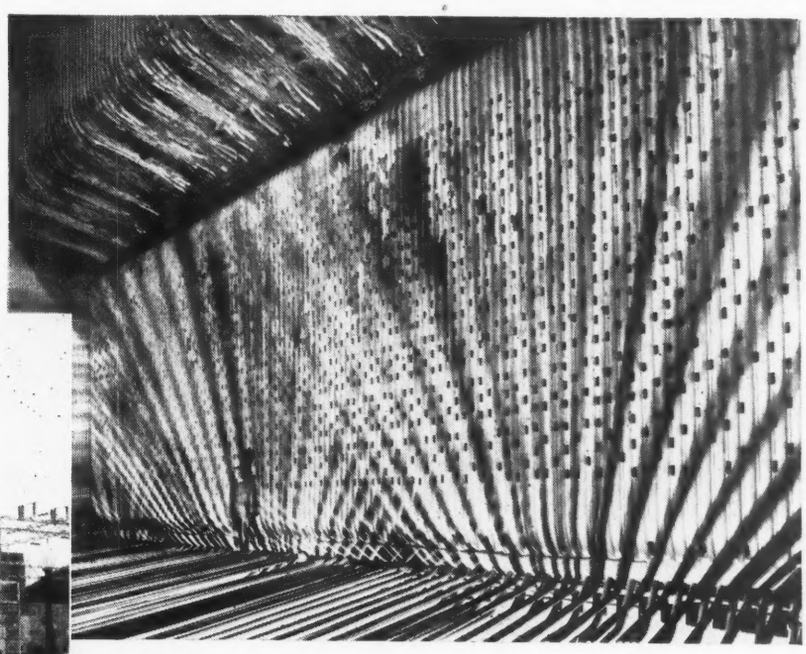
Synchronous Motors

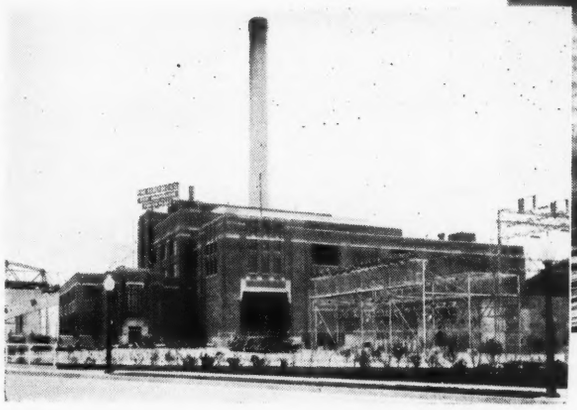
LINE of ac fractional-horsepower motors are applicable where long-lived source of low-speed torque at constant speed is needed. Motors built in 2-frame sizes, with two motors available in larger frame size, and four motors available in small-frame size. Motors are essentially inductor alternators operated as motors with an Alnico permanent magnet field replacing usual dc excited field. They are self-starting and have rapid acceleration and deceleration.

General Electric Co, Schenectady, N. Y.



WINNER OF THE CHARLES A. COFFIN AWARD





PORT WASHINGTON USES GLOBE "SEAMLESS FOR SAFETY" TUBES

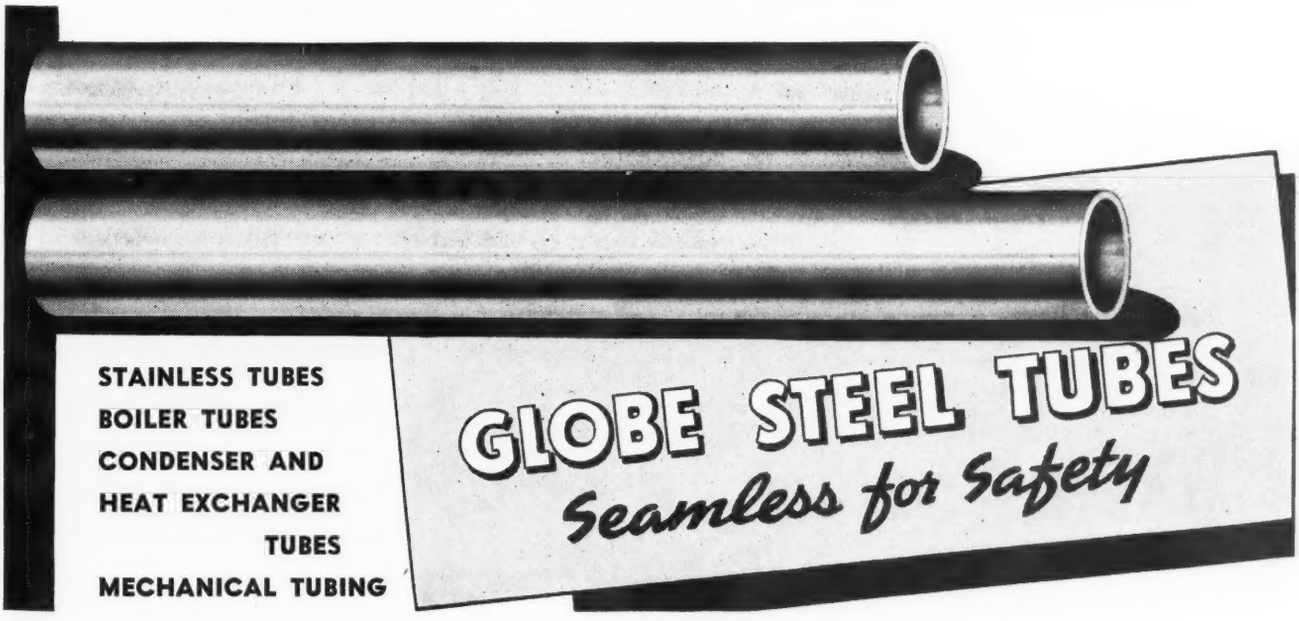
THE continuous service record of the Port Washington Station and excellent over-all performance throughout all the plants of the Wisconsin Electric Power Co., have won for this company the Charles A. Coffin Award for 1938 from the Edison Electric Institute.

Port Washington and many other stations of the Wisconsin Electric Power Co. depend on Globe "Seamless for Safety" Tubes for superior performance.

Power plants, railroads, industrial and marine boiler builders look to Globe Tubes for extra safety and strength — vital to meet modern high pressure and temperature demands.

Check with a Globe engineer before you specify boiler tubing.

GLOBE STEEL TUBES CO. • 4050 W. Burnham St., Milwaukee, Wis.



"MEGGER"
TRADE MARK REGISTERED U S. PAT OFF

"Know by TEST" — says E. T. L.

MORE THAN 20 YEARS AGO the Electrical Testing Laboratories of New York purchased their first "Megger" instrument as a rapid and practical means for testing insulation resistance of electrical equipment. This same instrument *is in use today*, and additional sets have been added to meet current demands . . . witnessing to the importance of the "Megger" Insulation Resistance Test as a means of detecting and preventing trouble, and to the outstanding ruggedness and reliability of "Megger" instruments.

The "MEGGER" Insulation Tester

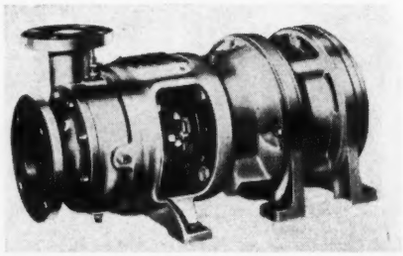
is a high-range direct-indicating Ohmmeter mounted in the same case with a hand-driven d-c generator which supplies test current at 500, 1000, 2500 or even 5000 volts according to the rating selected. The instrument can be used anywhere, at any time, and by any intelligent person. Motor-driven types for continuous operation are also available. Your copy of our descriptive "Megger" Catalog 1550-P will be sent promptly upon request.

JAMES G. BIDDLE CO.

ELECTRICAL AND SCIENTIFIC INSTRUMENTS, 1211 ARCH ST., PHILADELPHIA, PA.

Motorpump

"I-R" motorpump, for all types of general service, is built in sizes for delivery of 5 to 1000 gpm and heads up to 500 ft. Pump impeller mounted directly on shaft of elec-

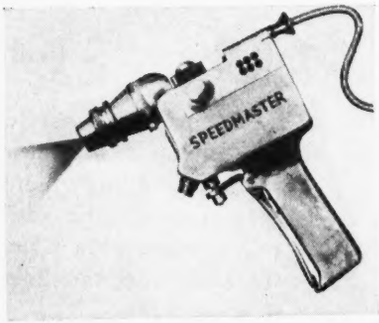


tric-motor drive. Entire unit enclosed in housing which requires no baseplate or foundation and may be bolted down for operation in any position.

Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

Metal-Spray Gun

"SPEEDMASTER" metal spray gun sprays all metals obtainable in wire or rod form. Has extra heavy bronze gears, and all shafts ball-bearing mounted and self-lubricated. Valves are of the poppet type, synchronized to operate by movement of



single lever, and unit has 1-piece wire nozzle, having only one gas joint. Also has impulse-type, curved-bucket turbine with throttle control for variable-speed ranges.

Master Metal Spray Co, 2527 Magnolia St, Oakland, Calif.

Tool Post Grinder

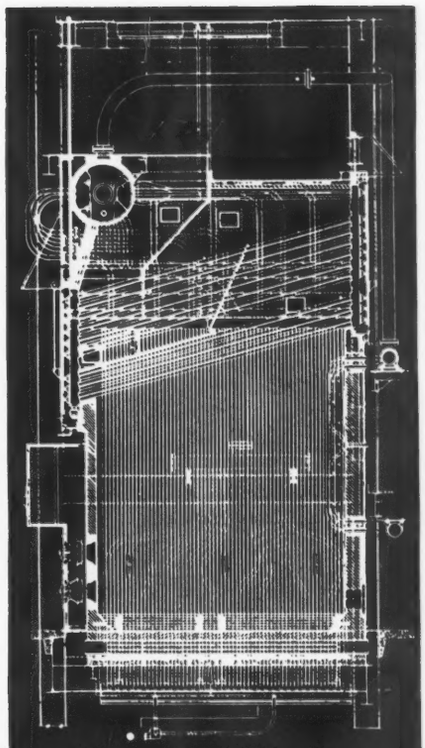
"ALL-PURPOSE" grinder applicable to many different uses, and can be adjusted to any plane or angle. Has eight speeds obtainable by switching pulley and sheave, and standard surface grinder wheels fit spindle either in special or standard thicknesses. Motor and bearings enclosed against dust and dirt, and wick-felt oiler keeps spindle lubricated.

R G Smith Tool & Mfg Co, 245 South St, Newark, N. J.

Recording Thermometer

LINE of recording and indicating thermometers constructed for temperatures from —40 to 1200 F. Flat, spiral-actuating

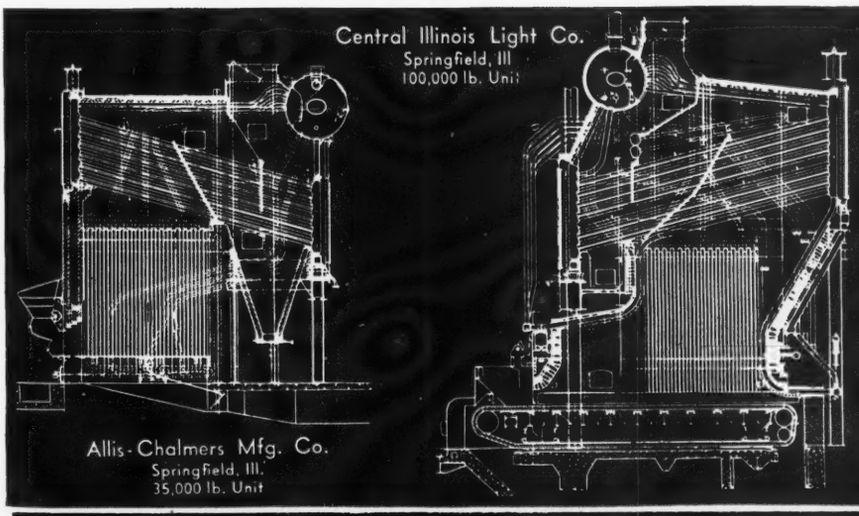
FEATURES Found Only in Springfield Units Are Largely Responsible for the Extra Dividends They Pay in Lowered Costs and Increased Service Hours!



Oklahoma Gas & Elect. Co.
Oklahoma City, Okla.
180,000 lb. Unit

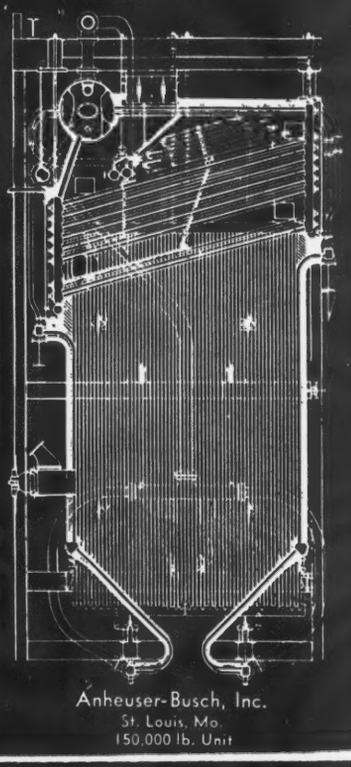
THE "Springfield Design" is not just another way of arranging tubes, drum, baffles, etc. Rather, it is the utilization of certain fundamental principles in design to secure specific benefits. We believe it is only a matter of good judgment for every prospective power boiler purchaser to learn why Springfield engineers have spent more than twenty years in specializing on this design exclusively. We will be glad to tell you the story, with no obligation.

SPRINGFIELD BOILER COMPANY
Springfield, Illinois
CHICAGO . PHILADELPHIA . DALLAS . OSWEGO
CINCINNATI . BATON ROUGE . NEW YORK . BOSTON
DETROIT . PITTSBURGH . MINNEAPOLIS . MEXICO CITY



Central Illinois Light Co.
Springfield, Ill
100,000 lb. Unit

Allis-Chalmers Mfg. Co.
Springfield, Ill.
35,000 lb. Unit



Anheuser-Busch, Inc.
St. Louis, Mo.
150,000 lb. Unit

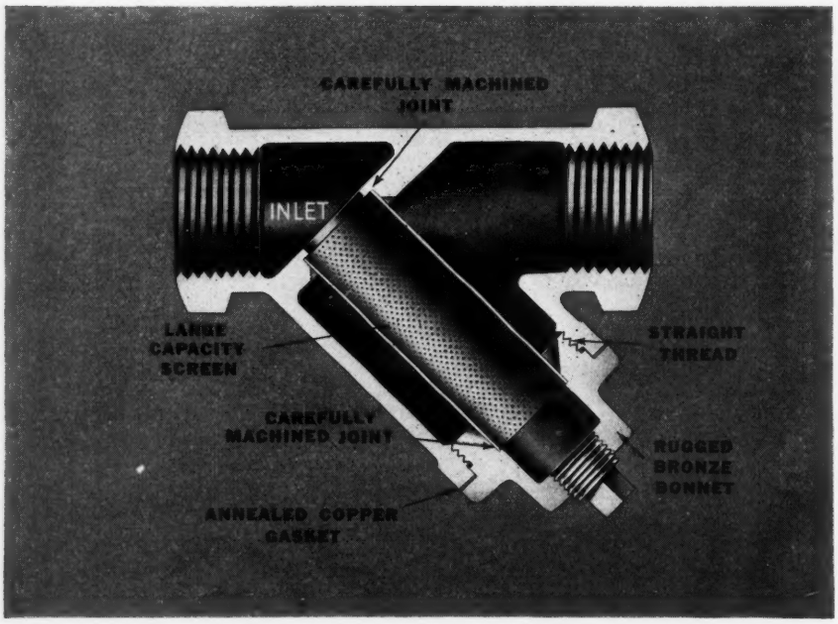
SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

TIME MARCHES ON · ·
AT YOUR EXPENSE



EVERY LINE OUT OF SERVICE COSTS MONEY BY THE MINUTE—

Minutes lost cost you money when regulator, valve or pump goes out of service due to scale, bits of packing, sediment, or other foreign matter lodging in the mechanism. Every engineer knows from experience the insurance value of pipe strainers. The wise engineer makes doubly sure of uninterrupted service by specifying Masoneilan strainers — a quality product with exclusive valuable features. Check these advantages before you buy any strainer:

Rugged Construction — bronze bodies in small sizes (¼″ to 1½″) fitted with heavy bronze bonnets and pipe plugs for blowoff. Iron bodies in sizes 2″ to 4″, with flanged iron bonnets and pipe plugs.

Precision Built — bodies and bonnets are carefully machined to assure uniform tight jointing at top and bottom of screen, no matter how often screen is removed for thorough cleaning. No leakage or buckling of the screen is possible. Gaskets facilitate removal of bonnet for cleaning screen.

Convenient — screen may be cleaned without removing strainer from the line.

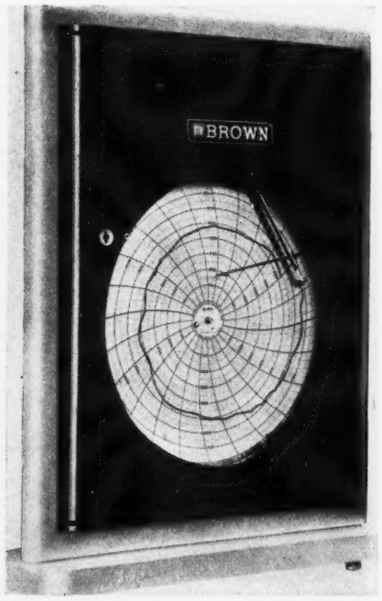
Efficient — brass screens with small perforations, (.02″ diameter) retain all but the smallest sediment. Large free area of screen assures no reduction in volume of flow even when screen is half full.

Be safe by using strainers at every vital point. Be doubly safe by specifying Masoneilan Strainers. Your mill supply distributor carries them in stock — or can get them quickly. Ask him for Bulletin No. 67. Or write our nearest office.

MASONEILAN
REG U.S. PAT. OFF.

1186 ADAMS STREET
BOSTON, MASS., U.S.A.

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH TOLEDO
TULSA CHICAGO ST. LOUIS HOUSTON LOS ANGELES
MASON REGULATOR CO. OF CANADA, LTD., MONTREAL, CANADA



elements have sufficient pen-torque without sacrificing speed of response. Special safety link between actuating element and pen provides overload safeguard protecting mechanism if pen is moved in either direction manually. Chart is firmly secured to driving mechanism by tapered stud, and tapered chart positioning stud, eliminating chart knob and chain.

Brown Instrument Co, Philadelphia, Pa.

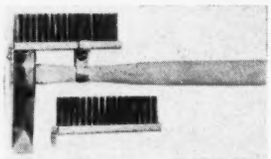
Proportioning System

"Xacto" system is designed to compound, blend or mix, oils, gasoline, and other liquids. Mixes from 2 to 5 or more liquids, and parts of the system can be discontinued when not in use. Consists of necessary Xacto meters, proportioning mechanisims, control valves, automatic shut-off valve, discharge header piping, and the mixer. Available in systems consisting of two or more meters in 1½,- 1¼,- 2- or 3-in. sizes.

S F Bowser & Co, Inc, Fort Wayne, Ind.

Chipping Hammer-Brush

Combination consists of drop-forged steel chipping hammer, with heavy-duty wire brush rigidly mounted on top side. Ham-



mer breaks and chips scale or other formation and wire brush cleans surface. Wire brush can be removed, reversed or replaced.

St. Pierre Chain Corp, 54 Frank St, Worcester, Mass.

Insulating Blankets

"Rockwool Blanket" manufactured by felting large flat sheets of B-H high-temperature-resisting insulating wool between

Making a Science of Service . . . Chase research in the condenser field is concerned first of all with investigating your condenser tube needs and determining, scientifically, the alloy that will meet them most economically. Chase engineers will be glad to help you without obligation. Just write.

CHASE CONDENSER TUBES

CHASE BRASS & COPPER CO., *Incorporated,* WATERBURY, CONN.

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

"Call in.. 'The SCAIFE MAN'

HE KNOWS WATER TREATMENT . . .

—AND IT'S DOLLARS TO DOUGHNUTS HE CAN HELP SOLVE OUR BOILER FEED WATER PROBLEMS"

A safe wager, Gentlemen! THE SCAIFE MAN *can* help you unravel the costly tangle that develops in power plant operation when boiler feed water is at fault. His specialized knowledge is broad-based on experience with every type of plant—all conditions of water—and sound methods of treatment well-proved in practice.

Count THE SCAIFE MAN *in* on your next discussion . . . and you'll have at your elbow the feed water lore of a long-leading organization in the field of water treatment—entirely without obligation. We cordially invite you to make use of this service at any time!

Scaife
MANUFACTURES FOR THE POWER INDUSTRY:
Water Softeners: Hot Lime Soda... Cold Lime Soda... Sodium Zeolite..Hydrogen Zeolite. Water Filters: Gravity... Pressure. Continuous Blowdowns; Zeolite Minerals; Filter Refills.
Let us quote you!

WM. B. SCAIFE & SONS CO.
FOUNDED 1802

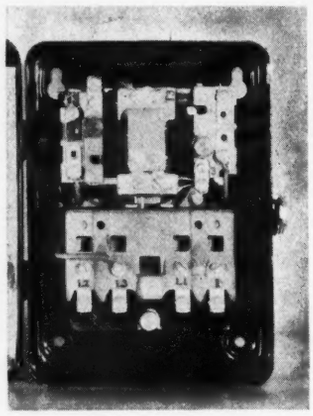
General Office, Laboratory and Works—OAKMONT, PA.
(Pittsburgh District)
Representatives in Principal Cities

various styles of metal fabrics. Standard sizes are 8 to 16 sq ft, making it possible to insulate large areas easily. Blanket is flexible, and according to manufacturers, will not break in handling. Can be applied to equipment having curved surfaces. Comes in 12 styles of blankets using different combinations of 4 metal fabrics: wire mesh, stucco lath, expanded metal lath, and rib lath.

Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.

Linestarter

DESIGNED for ratings up to two hp, 220, 440, and 550 v, linestarters are used for across-the-line starting of squirrel-cage induction motors, and as primary switches for wound-rotor induction motors. Starters built either as plain across-the-line starters or in

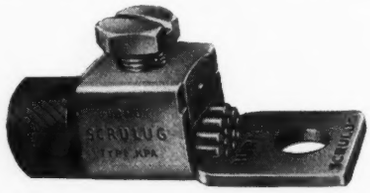


combination with motor circuit switches and Nofuze circuit breaker in standard enclosures. Principal features include Deion arc-quenching and snap-action bi-metal disk overload relay.

Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.

Electric Terminal

TERMINAL CONNECTOR designed to accomodate range of wire or cable sizes. Constructed in one piece, and has pressure strip to prevent clamping screw from dam-

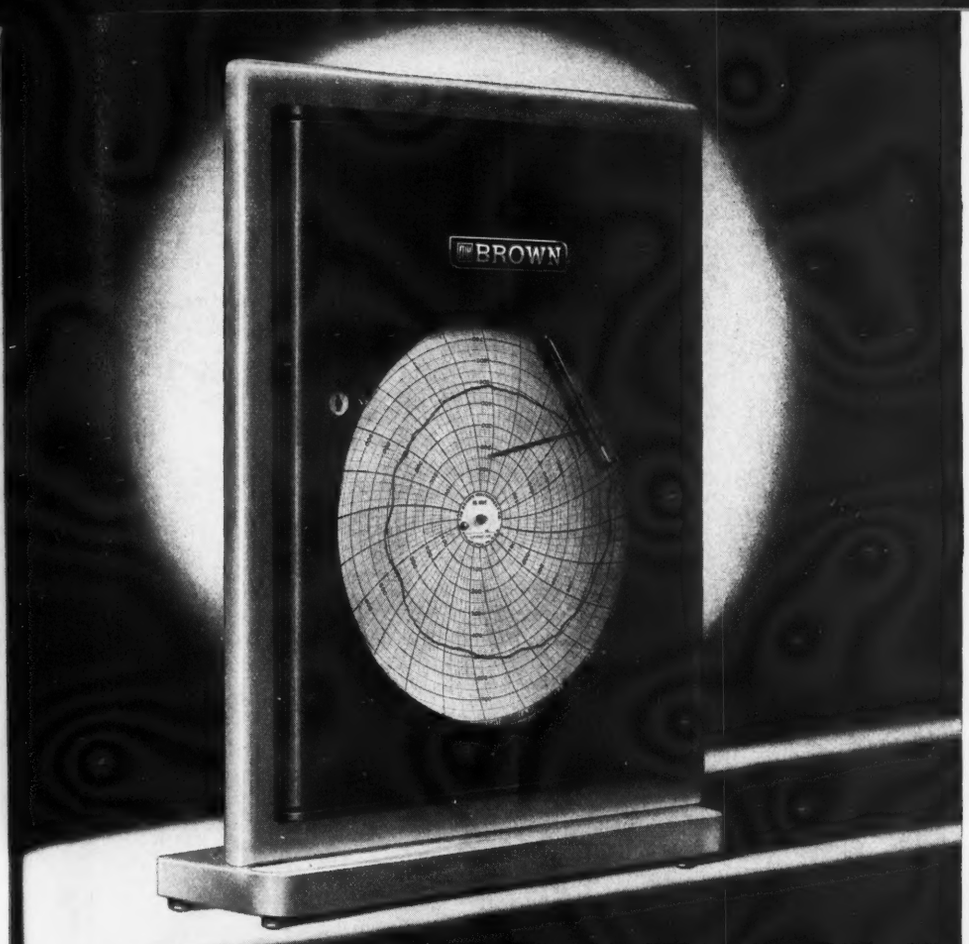


aging conductor. Entire conductor tinned to prevent corrosion and discoloration. Approved by underwriters, comes in sizes for all conductors from No. 14 to 4/0.

Burndy Engrg Co, Inc, 459 E 133rd St, New York, N. Y.

Welding Table

REVOLVING WELDING TABLE for welding tanks and other circular work. Table is



ADVANCED DESIGN

Assures Accurate Measurement with Simplicity

MODERN RECTANGULAR CASE

Styled by HENRY DREYFUSS

Designer of the
"Twentieth Century Limited"

The NEW BROWN THERMOMETER

EMBODIES FEATURES REQUESTED BY POWER ENGINEERS AND INSTRUMENT MEN

SPIRAL ACTUATING ELEMENTS: Powerful, flat spiral, ample torque, especially heat-treated to insure permanent calibration. Have exceptional over-range capacity.

OVERLOAD SAFEGUARD: A special safety link between actuating element and pen arm contains a two-way spring overload release which also protects the mechanism from damage if the pen is moved in either direction manually.

PEN SHAFT: Has sturdy outboard bearing, with hardened pivots, mounted on rigid casting. Unaffected by vibration.

PEN ARM: Stainless steel, 8" long, ribbed reinforcement, permits pen travel of 4¾". Easily removed and replaced, with no effect on calibration, micrometer adjustment assures precision setting.

PEN: Non-corroding, easily removed and cleaned; cannot be improperly replaced.

RESILIENT MOUNTING: A rigid, flat sub-plate with 3-point, resilient suspension mounting carries all moving parts. Insures permanent alignment—even though case mounting is distorted, accuracy is unaffected.

CHART PLATE: Supported from sub-plate; finger tip release permits easy removal without tools.

PEN LIFTER: Integral with chart plate; manually operated and provided with limit stops.

TIME INDEX: Integral part of chart lifter for setting pen at correct time limit.

CHART DRIVE: Chart is firmly secured to driving mechanism by tapered hub and tapered chart positioning stud. Charts are punched to correspond with tapered studs on driving hub. Only necessary to place chart over studs which lock it firmly to driving mechanism. Eliminates chart slippage. No knobs or chain.

AUTOMATIC CHART TIMING: Charts when renewed are automatically in time; as the tapered position stud is in effect the hour hand of the electric clock. If current failure makes it necessary to reset chart to correct time line, a friction clutch permits manual rotation for chart setting.

CHART CLIPS: Mounted on door, an integral part of shield which conceals operating mechanism.

ADAPTOR BLOCK: Designed to permit easy removal of actuating element for replacement or change of range by user. Firmly anchors external connections to case with no strain on operating mechanism. Adaptable for bottom or back connections. Connection provided for ¾" conduit.

RECTANGULAR CASE: Die-cast aluminum, dust and moisture-proof. New special baked durable black enamel finish, created to resist moist salt or acid atmospheres. Permits flush or front-of-board mounting.

TERMINAL BLOCK: Moulded Bakelite with screw terminals separated by baffles and covered insulating plate.

The above-mentioned features are but a few of the many new developments found in the new Brown Thermometer and Pressure Recorders. Why not learn more about them? Get full details by writing THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter St. . . . Amsterdam-C, Holland: Wijdesteeg 4. . . . England: Wadsworth Road, Perivale, Greenford, Middlesex. . . . Stockholm, 16, Sweden: Nybrokajen 7.

BROWN THERMOMETERS AND PRESSURE GAUGES

Accurate Measurement with Simplicity

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TRADE FRICK MARK
Refrigeration
Air conditions the Office Building of the Home Owner's Loan Corp., the Administration Building of the Dept. of Agriculture, the new Police Court, and the Medical Arts Offices—in addition to numerous theatres, stores, and restaurants.
Frick Equipment also provides cold drinking water throughout the Dept. of Commerce Building, the National Museum, Library of Congress, Govt. Printing Office and Bureau of Engraving; it does test and research work for the Bureau of Standards and the Navy Department; it makes ice in several large commercial plants, cools milk at the Chestnut Farms and eight other dairies, freezes ice cream in four plants, keeps food fresh at ten colleges and schools, and in many hotels, markets, etc.
Whatever your needs, look to Frick Engineers for complete and competent cooling service.
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

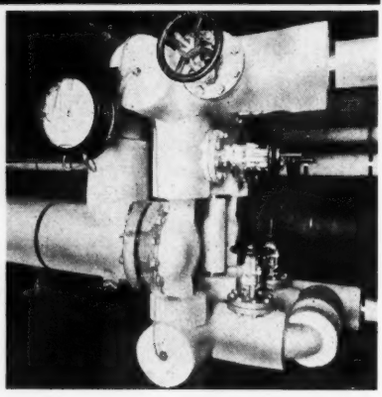
BALDWIN-HILL

HEAT INSULATION PRODUCTS

For *maximum efficiency* in cutting heat loss, lowering costs and stepping up production, investigate the performance record of B. H. high temperature insulations.

Write for Catalog Showing Complete Line

BALDWIN-HILL CO.
575 Klagg Ave. Trenton, N. J.



No. 1 Insulating Cement

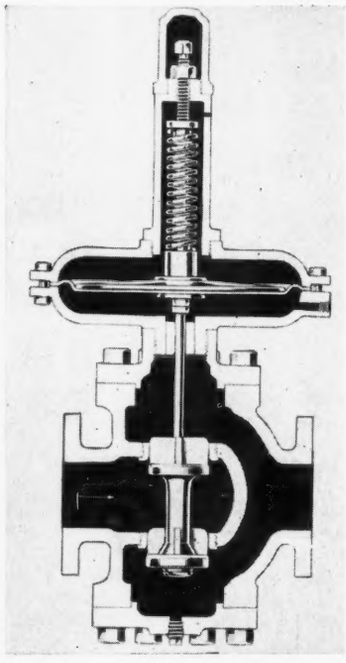
An ideal maintenance insulation, effective up to 1800° F. and 100% reclaimable up to 1200° F. Has high coverage and low volume shrinkage. Is highly adhesive, easy to mix and apply.

31 in. in diameter and 25 in. high when horizontal. Has 8 lines of radial slots for bolting work to frame, and is tilted by hand-operated self-locking worm and wheel. Unit tilts to vertical position either side of center line, and in this position will carry load of 600 lb, with maximum diameter of 34 in. Table is driven by ¼-hp electric motor driving through variable-speed transmission and worm-gear reducer. Range of table speeds .055 to .333 rpm corresponds to welding speeds of .43 to 2.6 ft per min, on 30-in. diameter. Speed is adjusted by handwheel on side, and table can be driven in either direction.

Ransome Concrete Machinery Co, Welding Div, Dunellen, N. J.

Reducing Valve

TYPE 217AS, illustrated, is designed for transmitting reduced pressure after receiving a higher or varying pressure on the inlet side. Unit is spring actuated and has



no dashpots or pistons. Valve stem is guided into diaphragm casing and connected to inner valve by "Flexaline" connection.

Fisher Governor Co, Marshalltown, Iowa

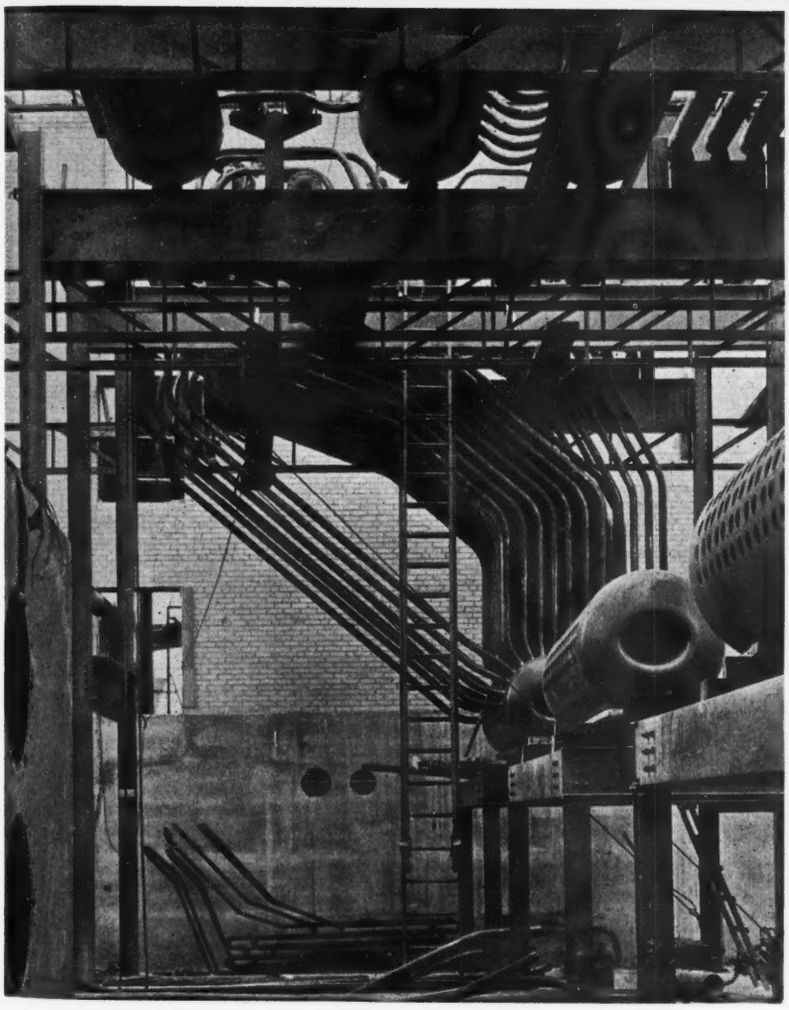
Desuperheater

STEAM-ATOMIZING type is designed to give complete atomization of desuperheater water at all flows by impact of a small quantity of high pressure steam at constant velocity and thus provide complete range of operation from 0 to maximum. Can be mounted in any plane in any horizontal or vertical line. Atomizing steam is taken from high-pressure system or, if reducing valve is installed, from above valve. Desuperheater built in 2 standard sizes for any steam capacity and for any pressure and temperature conditions up to and including 1250 lb, 950 F.

Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.

Another important boiler installation by

EDGE MOOR



Side view of installation in process of erection, showing first boiler partially tubed out with drums of second and third boilers in place.

3-403 HP UNITS . . . . being erected complete by EDGE MOOR for LAKELAND INSTITUTION, Camden, N. J.

This installation involves 3 Four Drum Bent Tube Boilers, each 403 H.P. for operation at 450 lb. pressure and with superheaters for 650°. Included in this job are oil firing equipment, water walls and economizers.

By placing the contract with Edge Moor for handling the erection of the job complete, this power plant has taken advantage of Edge Moor's long experience and modern engineering to insure the maximum in operating efficiency, economy as well as the minimum in maintenance.

- Bent Tube Boilers
- Straight Tube Boilers
- Superheaters
- Water Walls
- Economizers
- Air Preheaters

EDGE MOOR IRON WORKS, INC. 30 Rockefeller Plaza, New York, N. Y.

Kansas City Chicago Detroit Richmond, Va.

In Canada UNITED STEEL CORPORATION, LTD. Toronto Montreal

Announcing FAIRBANKS NEW BRONZE GATE VALVES

This new line of Bronze Gate Valves is a triumph of Fairbanks' half-century experience in research and engineering. Quality and craftsmanship stand out in every major and minor detail.

The new designing of parts and the more rugged construction assure easier operation, longer life and lower maintenance cost.

Here are some of the features of these new valves:

The large Bonnet Hex projects over the bonnet threads and provides more strength, greater wrench surface, easier dismantling and less breakage. Larger, stronger Pipe End Hexes provide a better wrench grip and prevent distortion.

The heavy bronze body is reinforced with Ribs at the side and bottom, giving additional strength for withstanding pipe strain.

Large clearance between end of threads and diaphragm prevents long threaded pipe from damaging seats. Greater length of threads assure tighter, stronger pipe joints.

All Wedges are reversible. Rib guides in body assure perfect alignment and seating. Heavy internal ribbing of wedge prevents distortion when valve is subjected to sudden shock.

Non-rising stem valves are furnished with Solid Tapered Wedge having a full thread engagement with stem when closed. The rising stem type is regularly equipped with a Slip-on Solid Tapered Wedge, Split Wedge of ball and socket design can be furnished when desired.

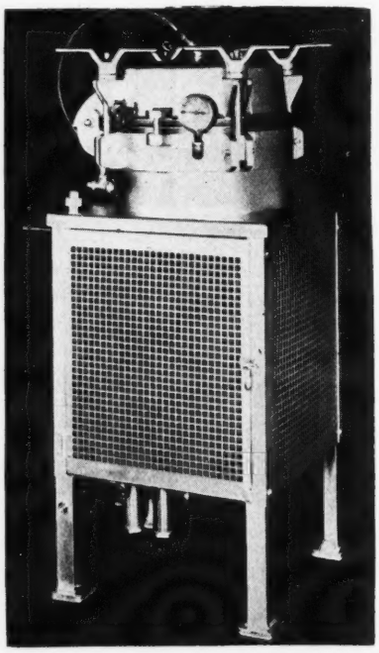
Made in sizes from ¼ in. to 3 in. for 125 lbs. pressure. Sold by distributors everywhere.

Write for our new booklet describing detailed construction of these valves.

THE FAIRBANKS COMPANY
397 LAFAYETTE ST., NEW YORK, N. Y.
Boston, Pittsburgh—Distributors in Principal Cities
Factories: Binghamton, N. Y.—Rome, Ga.

Oil Reclaimer

MODEL "B" is smallest unit placed on market, but will still handle diesel installations up to 500 hp. Is direct-connected to lubricating systems of diesels.



Hilco is continuous-type oil purifier using absorbent clay which removes all contaminations such as acidity, carbon, sludge, abrasives, and restores favorable color. Unit is 17½x17½x38 in.

Hilliard Corp, 4 W 4th St, Elmira, N. Y.

Rivet-Bolt

DARDELET "Rivet-Bolt" is made of carbon-manganese steel with specially formed button head similar to rivet but with ribbed grip portion slightly greater in diameter than punched and drilled holes in structural-steel connections in which it is used. Rivet-bolt is driven into hole with 7- or 8-lb maul to produce bound fit in the hole. Thread end of unit is formed with Dardelet self-locking screw thread on which nut is turned and tightened.

Dardelet Threadlock Corp, 55 Liberty St, New York, N. Y.

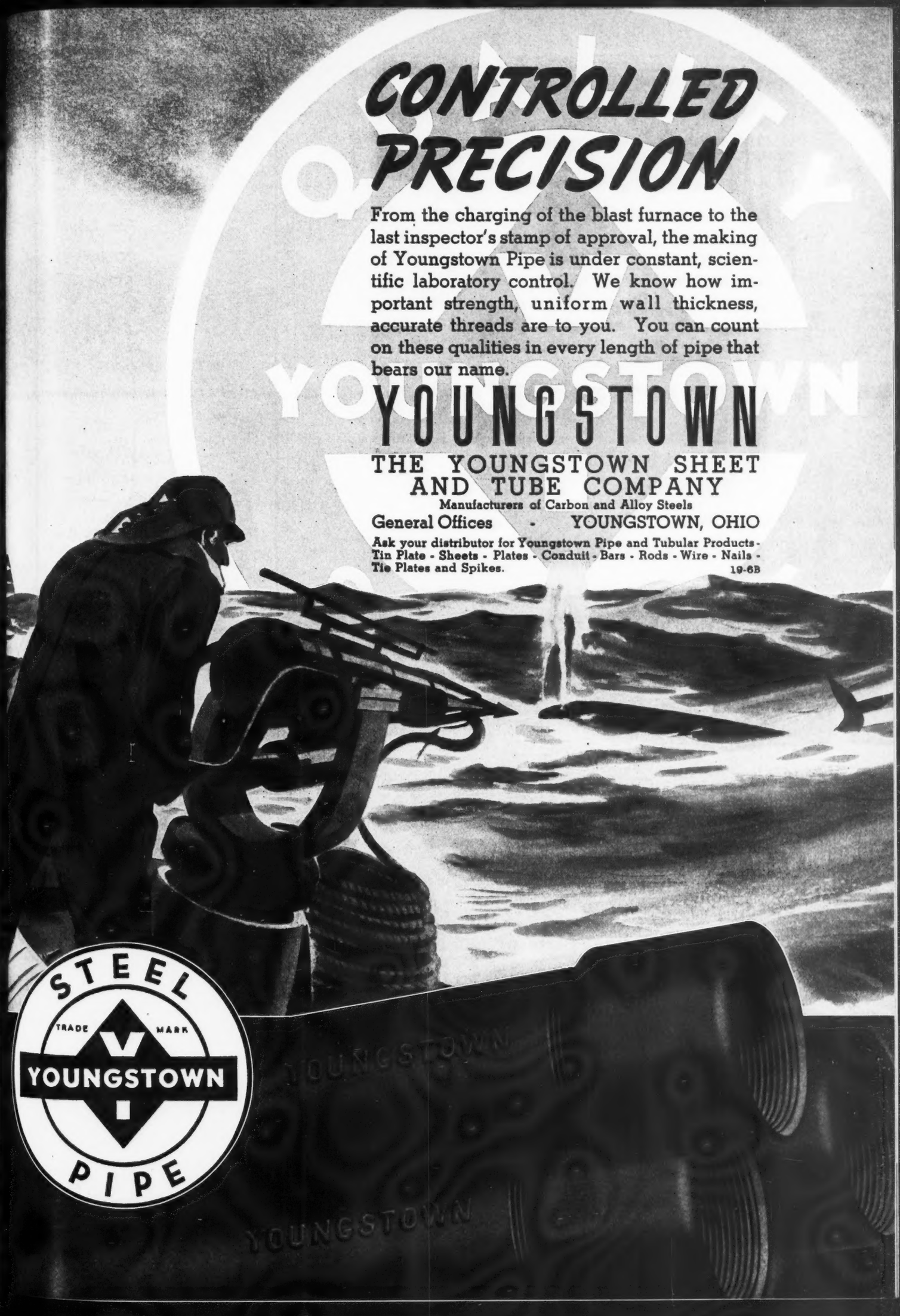
Alloy Steel

CROLOY 7 is alloy steel for high-temperature service in tubular form, and contains chromium, carbon, molybdenum, and silicon. Data on high-temperature strength, short-time high-temperature properties, and other characteristics, under observation.

Babcock & Wilcox Tube Co, Beaver Falls, Pa.

Evaporative Cooler

TRANE cooler has been designed to cool diesel-engine jacket water in a closed system. Unit claimed to provide maximum efficiency in cooling jacket water, and to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PRECISION
From the charging of the blast furnace to the last inspector's stamp of approval, the making of Youngstown Pipe is under constant, scientific laboratory control. We know how important strength, uniform wall thickness, accurate threads are to you. You can count on these qualities in every length of pipe that bears our name.
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PIPE

YARWAY INVOLUTE SPRAY NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

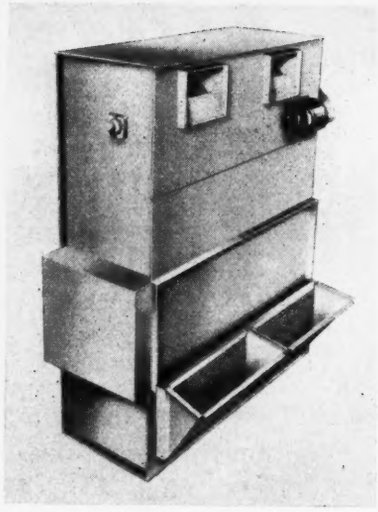
Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-615.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia



eliminate troubles usually encountered with open-type systems. Water used in unit is recirculated without any appreciable addition of makeup water. Under normal operating conditions, temperature of spray water is low so as to prevent precipitation and scale formation on outside of coil, but where hard or alkaline water is used, chemicals should be added.

Trane Co, La Crosse, Wis.

Clamp-Ammeter

WESTON clamp-ammeter permits measurement of ac current without breaking circuit. Has 6 ac ranges from 0 to 500 amp, will hold conductors up to 2 in. in diameter, and has 6-position switch. Laminated clamping jaws insulated with heavy rubber sleeve said to withstand a breakdown test of 10,000 v, ac, and instrument is removable for remote indications. Handle and trigger are of Bakelite, and scale built with shatterproof-glass cover. Size is 13⅝ x 4⅝ x 3½ in.

Weston Electrical Instrument Corp, 11 Park Place, New York, N. Y.

Circuit Breaker

TYPE MO Multi-breakeR available in 15-, 20-, and 25-amp sizes for 115/230-v single- and 2-pole applications where type D fusible switches have been used. Will open circuit under same overload conditions

Save Air—Save Dollars

ROCKWELL BLAST GATES

Threaded Slide Type

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For Low Pressure Air

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Slide Type
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W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK

OLD operating men know Dixon's Graphite by long experience. The youngsters have learned it too. So have their bosses.

That's why Dixon's Ticonderoga Flake Lubricating Graphite, popular for more than half a century, is still a favorite the world over. Through all the development in equipment, with pressures and temperatures higher than ever, this fine old Dixon product has more than held its own.

As a co-lubricant with oil or grease —for coating packings or gaskets— and on all joints—Dixon's Ticonderoga Flake Lubricating Graphite is unequalled—because it stands up to its work where other lubricants squeeze out, burn out, or wash out.

Particle Size No. 1—large, unctuous flakes.

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Rugged Strength

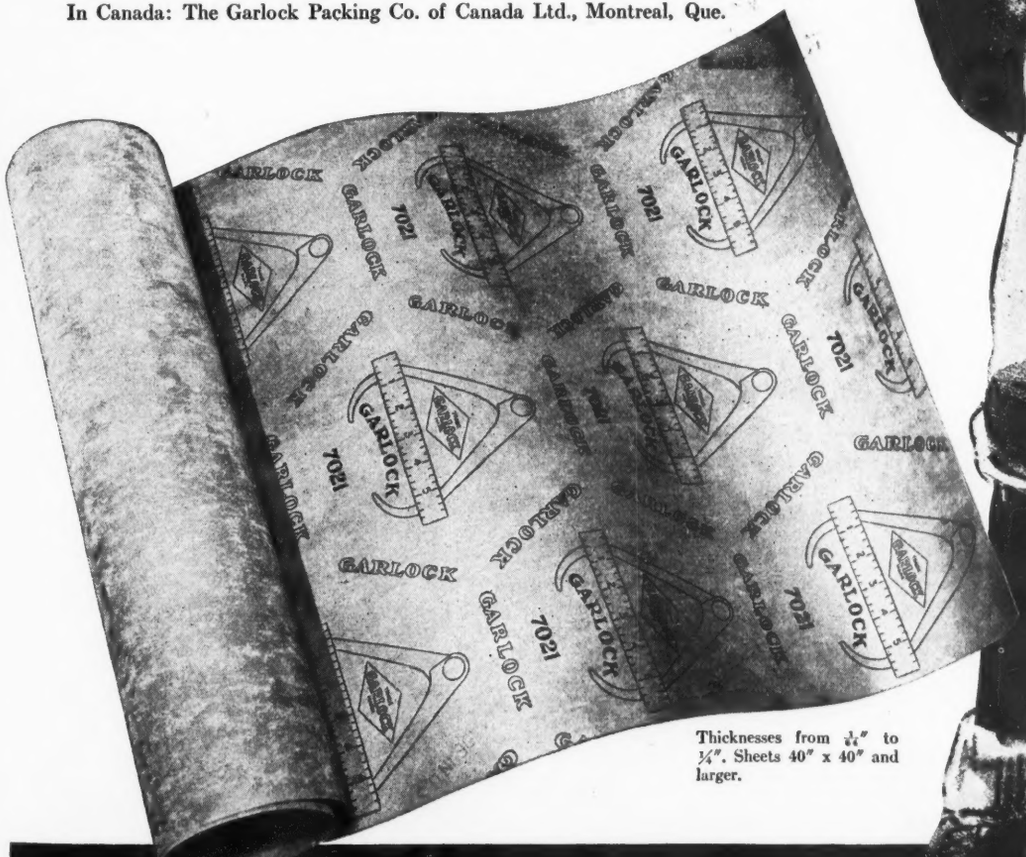
Garlock 7021

Compressed Asbestos Sheet Packing

The outstanding player on any football team is the one who has *rugged strength* to back up his superior playing ability. GARLOCK 7021 Compressed Asbestos Sheet Packing has this same quality—*rugged strength* to withstand extreme pressures and high temperatures.

Under the most severe conditions—such as super-heated high pressure steam and light oils at high temperatures—GARLOCK 7021 will stand up where ordinary gasketing materials fail. Order a supply of GARLOCK 7021 *today*. You'll like it!

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.



Thicknesses from 1/64" to 1/4". Sheets 40" x 40" and larger.

ONE ALWAYS STANDS OUT!

GARLOCK

Why not remove the cause?

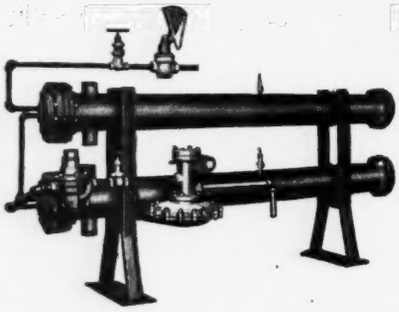
That's the obvious solution to any problem — and especially boiler troubles such as priming, foaming, scale formation, and carry over. Remove the cause—yes, but how?

The Henszey Continuous Blowdown system will maintain your boiler water concentration at a pre-determined proper degree by drawing off the accumulated impurities. And, remember this—that blowdown is done continuously, automatically and *without heat loss*, with a Henszey System!

Write for further information.

HENSZEY COMPANY

Dept. D-10 • Watertown, Wis.



A Henszey System made up of Low and High Temperature Heat Exchangers, Proportioning Valve, and the two items described below.

FEED WATER METER

While this accurate meter is primarily designed to measure boiler feed water and blowdown, it has been successfully used with other liquids that are ordinarily difficult to measure.

FLOW INDICATOR

For steam, water, and other fluids this accurate instrument goes right in the pipe line. There are no complicated parts to get out of order. Sanitary model meets all requirements for milk and other food fluids.

HENSZEY

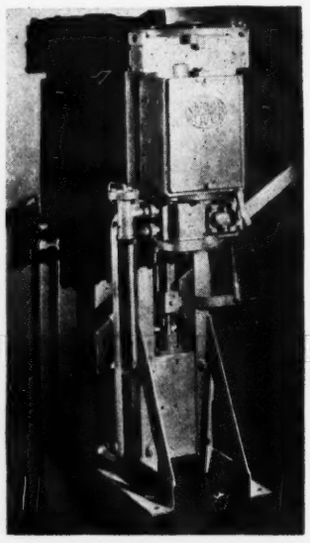
BOILER WATER CONCENTRATION CONTROL SYSTEMS

every time, but will not open circuit during brief period of high inrush circuit encountered in starting motors. No parts necessary to restore service, just the snap of a switch.

Square D Co, Detroit, Mich.

Hydraulic and Pneumatic Type Regulators

REGULATORS incorporate new features, such as measuring elements equipped with adjustable weighbeams, provisions for remote hand control and standardized designs of supporting stands. Adjustable weighbeam is designed to facilitate ad-



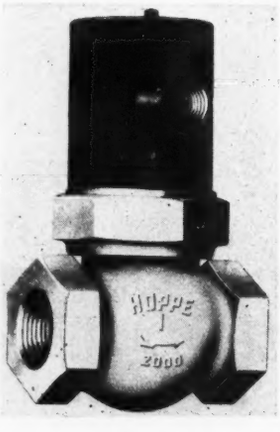
justments of ratios between any two controlled quantities, all adjustments being made while regulator is in operation. Remote hand control allows individual regulator and power piston and controlled device to be positioned manually from a remote point.

Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.

Solenoid Valve

TYPE D valve made of steam bronze, suitable for pressures up to 150 lb steam, 400 lb gas and liquid. Test pressure, 650 lb hydrostatic. Coils are impregnated to re-

(*Continued on page* 160)



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The only major development in Visible Record Systems Equipment in 15 years!

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No Matter how large or how small record requirements are Super-Visible can ideally meet them.

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NOW! Visible Records can be installed as fast or faster and more economically than conventional "blind" card systems.

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VISIBLE RECORD SYSTEMS EXCLUSIVELY SINCE 1914

● Efficient Diesel operation, freedom from breakdowns and tie-ups demand efficient lubrication. Only lubricants that stand up—lubricants engineered to the job—can give efficient lubrication.

Cities Service Diesel lubricants are *Service Proved.* They have been tested—proved by years of service—to be lubricants that give outstanding service.

The Cities Service Lubrication Engineers have a wealth of experience in prescribing and checking results in the Diesel lubrication field. You can draw on this background, this experience, to answer your lubrication problems. The Lubrication Engineers' Service is free.

A new booklet, "Diesel Engine Lubrication" is now on the press. MAIL the attached Coupon for your free copy—Today.

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SIXTY WALL TOWER—ROOM 1626P, NEW YORK, N. Y.

Please send me a copy of your *Free* folder "Diesel Engine Lubrication"..... (check box) ☐

Name .....

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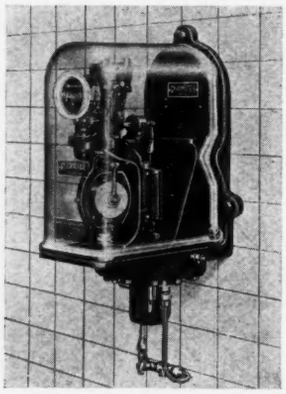
SERVICE PROVED INDUSTRIAL OILS

The Same Device

that flies this ship



operates the new • SIMPLEX • GYROMETER

Now, for the first time, gyroscopic force actions as employed in compasses and stabilizers have been utilized to measure the flow of fluids. While the mathematical theory of the gyrometer is somewhat complex its design is simple and its performance both accurate and positive. Through a wide range of connections the Simplex Gyrometer is adaptable to any primary device, any size main, any capacity and any fluid from water or corrosive liquids to steam and gas . . . The price? Very reasonable.

Write us today for interesting Technical Data

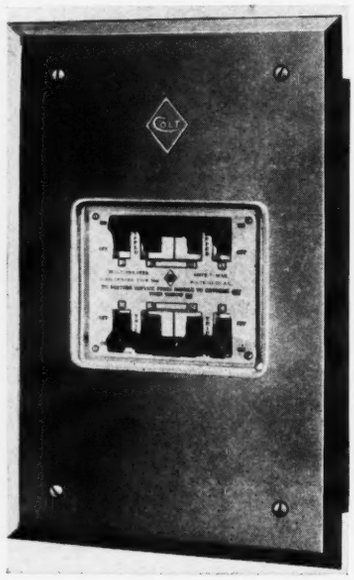
SIMPLEX VALVE & METER CO.
6780 Upland Street
PHILADELPHIA, PA.

sist moisture. When electric pilot valve is closed, line pressure forces piston down, closing valve. When pilot valve is electrically energized it opens and releases pressure above piston, which area is greater than valve opening, permitting line pressure to force piston up, opening valve.

Hoppe Engrg Co, Indianapolis, Ind.

Multi-Breaker Load Center

AVAILABLE in 3 types, for 1 to 16 circuits, units operate without fuses, and are of the "on-off" toggle type. Constructed with



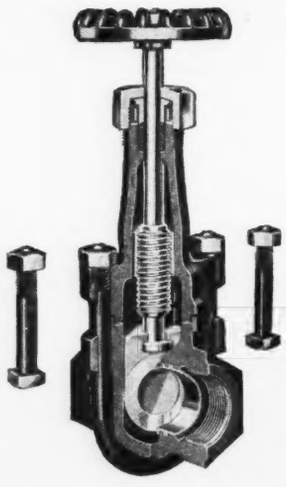
breaker ratings from 15 to 50 amp, and can be supplied with raintight boxes for outdoor installation. Type MB illustrated.

Colt's Patent Fire Arms Mfg Co, Electrical Div, Hartford, Conn.

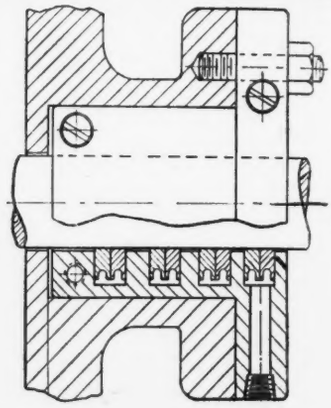
U-Bolt Gate Valve

"DUO-BOLT" valve has U-bolt replaceable with standard stock bolts and large drain duct to allow fluids to flow back into body when piping operations are discontinued. Also has self-seating, horsehoe-shaped, slip-on wedge of standard taper, available in malleable iron or steam bronze.

Ohio Injector Co, Wadsworth, Ohio

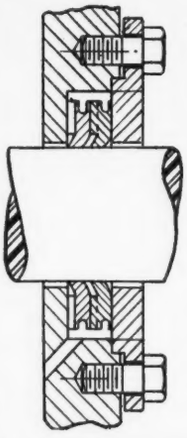


FRANCE Metal Packing



Reduces Friction

Due to its long-wearing qualities and because it reduces friction to the minimum, France Metal Packing has been adopted as standard equipment by numerous engine and compressor builders. Accurate and prompt service for complete sets or renewals for existing packing cases.



Saves Oil

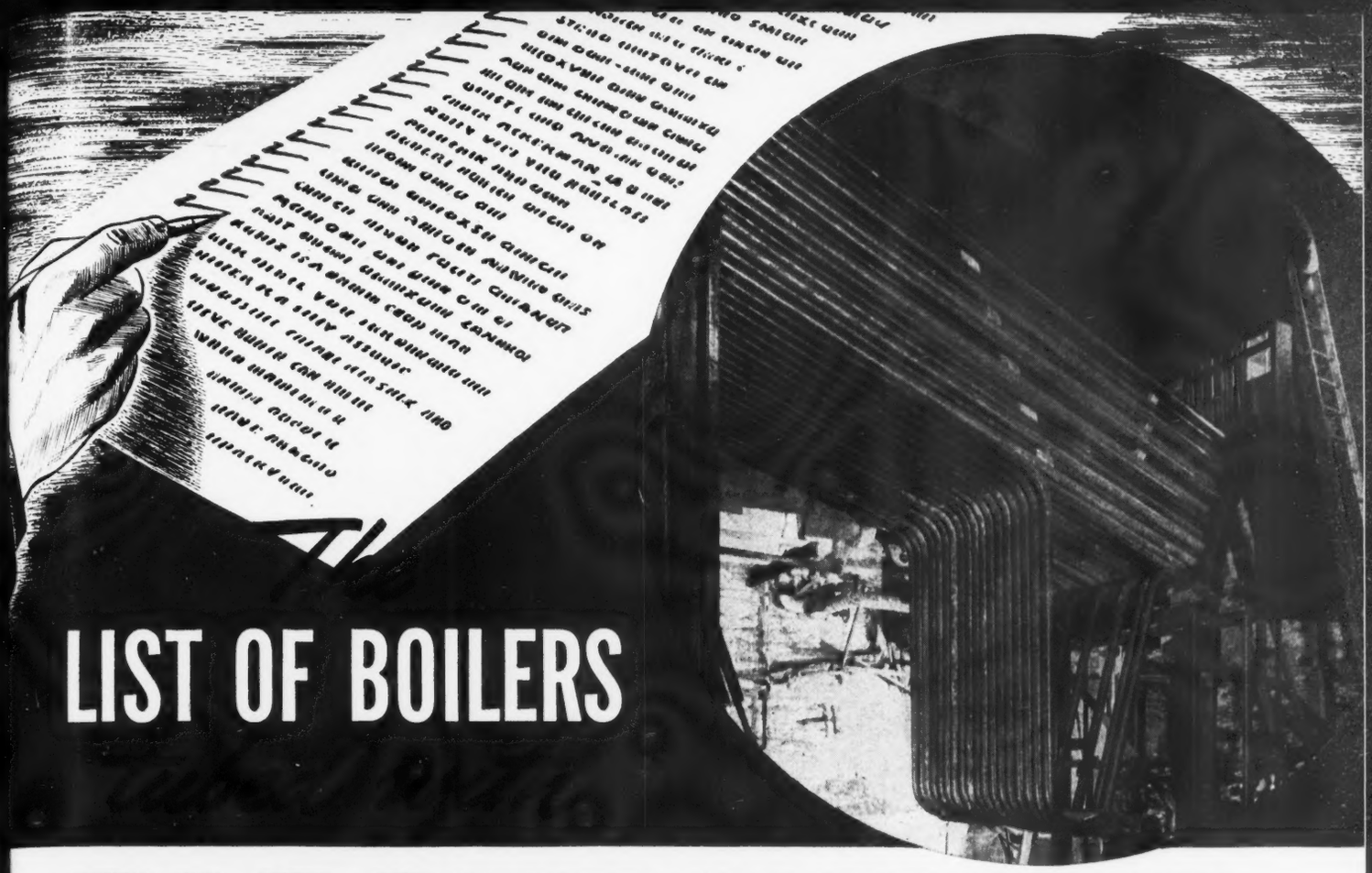
The oil return packing illustrated at left shows how crankcase oil is conserved with this type of installation. Used for years . . . the world over. Write for catalog of commonly used types and list of users.

THE FRANCE PACKING CO.
Tacony, Phila., Penna.
Branch offices in principal cities

ORIGINAL FRANCE METAL PACKING

Sold on approval
Satisfaction Guaranteed

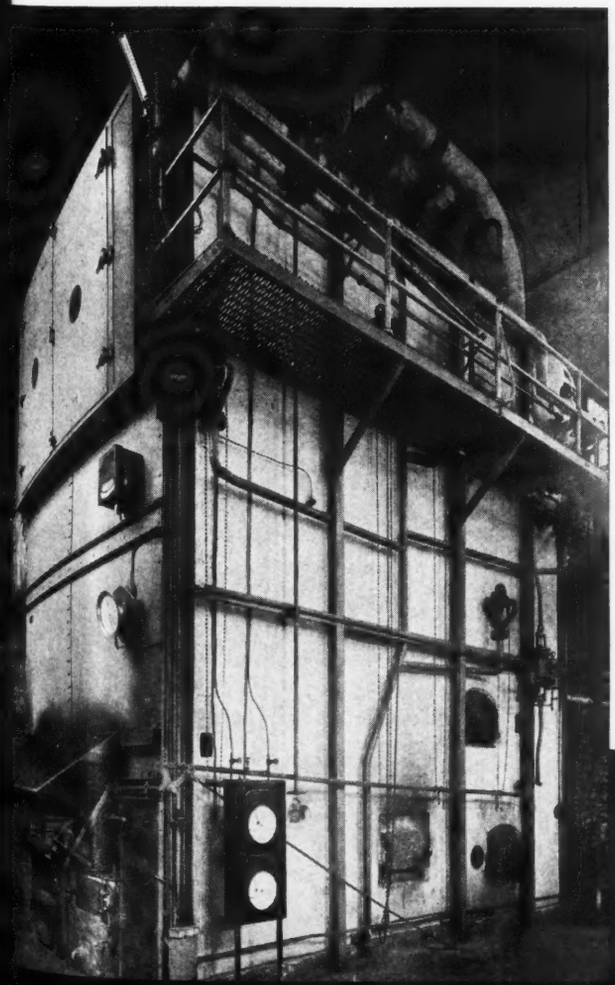
Original FRANCE METAL PACKING



ELECTRUNITE

REG. U. S. PAT. OFF.

THE MODERN ELECTRIC RESISTANCE WELDED BOILER TUBES

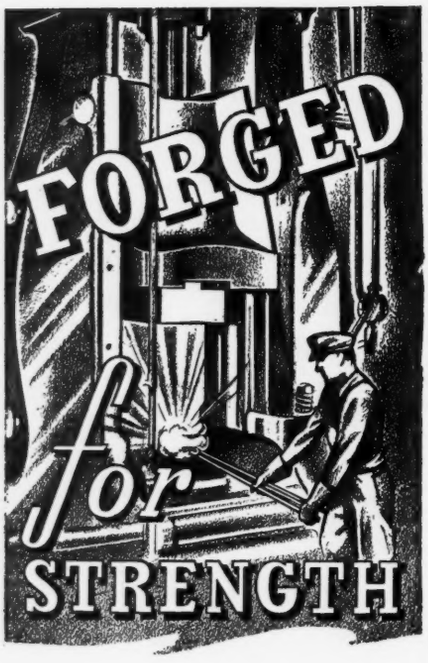


—HAS GROWN— *Rapidly!*

In building this 450 h. p., 200 lbs. operating pressure and 387° F. temperature cross drum boiler for the Rosewood Training School, Owings Mill, Md., E. Keeler Company used ELECTRUNITE Tubes.

In building countless boilers of every type—from small home-heating units to huge steam generators—manufacturers have used and continue to use these modern tubes.

The list of ELECTRUNITE-tubed equipment keeps growing—rapidly—because ELECTRUNITE Tubes have proved that they are easy to install, safe in service, long in life and low in cost. Let us show you facts and figures.

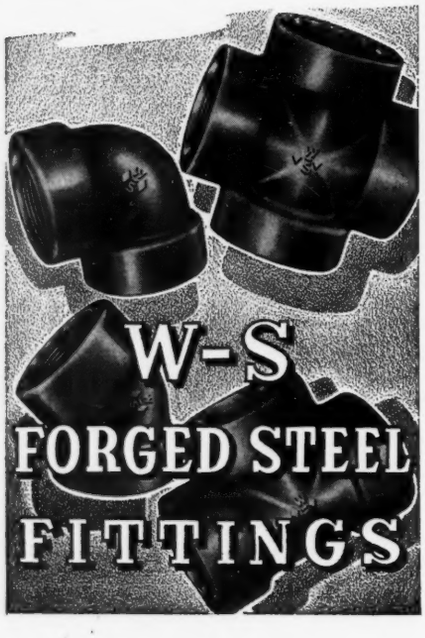


Pipe line failures on high pressure, high temperature systems, in addition to the danger involved are a source of excessive maintenance expense.

If you have been experiencing persistent pipe line trouble, W-S Forged Steel Fittings may be the solution to your difficulties.

Drop forged from open hearth steel, bored from solid forgings, W-S Fittings afford an extra margin of strength where it is vital and necessary.

Both screwed and socket welding fittings are available in a complete range of type and sizes. Order them from your distributor. The Watson-Stillman Co., Roselle, N. J.



STRAWS

Pointing the way business winds blow

ALABAMA——Southern Cement Co, Chamber of Commerce Bldg, Birmingham, plans 1-story addition to mill at North Birmingham, to replace structure recently destroyed by fire. Cost about $100,000. Burrell Engrg & Construction Co, 400 West Madison St, Chicago, Ill., engineer.

War Dept, Washington, D. C., plans central-heating plant, pumping station, water system and other utilities at new army air depot, near Mobile, where tract of land has been secured. Hangars, shops and other buildings will be erected. Fund of about $8,000,000 has been authorized for projects. Major A F Dershimer has been appointed constructing quartermaster for development and has established temporary offices in Chamber of Commerce Bldg, Mobile.

Southern Wheel Div, American Brake Shoe & Foundry Co, 700 Sixth Ave South, Birmingham, plans erection of three 1-story shop additions for increased capacity. Cost about $100,000, with power equipment and machinery.

Tennessee Valley Authority has announced the award of contracts totaling $2,000,000 for equipment to double power output of Wheeler Dam in northern Alabama. Will install two 32,400-kw generating units. Baldwin-Southwark Corp, Philadelphia, Pa., will supply two turbines for $784,992 and General Electric Co will furnish generators for $1,009,987.

CALIFORNIA——Northrop Aircraft, Inc, 126th St, Hawthorne, plans 1-story airplane-manufacturing plant on local site at Crenshaw Blvd and 126th St, initial unit to total about 100,000 sq ft of floor space. Cost close to $175,000, with power equipment and machinery. B G Reed is company engineer.

Bureau of Yards and Docks, Navy Dept, Washington, D. C., will award contract soon for power plant at naval air station, Alameda, one section to be 55 x 109 ft, and 44 ft high, and other section, 51 x 72 ft, and 34 ft high. Appropriation of $725,000 is available for this and two storehouse buildings at station.

COLORADO——State Bldg Dept, Denver, has taken out permit for 2-story power plant, 87 x 125 ft, at 1341 Sherman St, for service for state buildings. Cost about $150,000. Work will proceed at once. Gordon D White, 615 Columbine St, architect.

CONNECTICUT —— Northam Warren Corp, 191 Hudson St, New York, N. Y., plans cosmetic-manufacturing plant on Barry Pl, near Fairfield Ave, Stamford, totaling about 170,000 sq ft of floor space. Power house will be built for heating service. Cost estimated about $250,000.

Dorr Co, Inc, Danbury Rd, Norwalk, plans 2-story addition, 80 x 170 ft, to chemical-machinery-manufacturing plant. Cost reported over $80,000. Leo F Caproni, 1221 Chapel St, New Haven, architect and engineer.

FLORIDA——Homestead plans improvements in municipal power plant, with new diesel-generator unit and equipment. Cost about $60,000. William Sydow, 3461 Main Highway, Coconut Grove, consulting engineer.

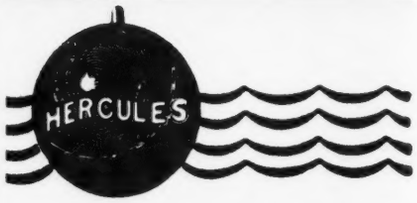
St. Cloud, has plans for municipal artificial gas plant and will begin work early this fall. Estimates of cost are being made.

GEORGIA——Thomasville Ice Mfg Co, Thomasville, has approved plans for 2-story addition to ice-manufacturing and cold-storage plant, 53 x 56 ft. Cost about $35,000 with equipment. Work will begin soon. C T Baker, 713 Glenn St, SW, Atlanta, consulting engineer.

IOWA——New London has awarded contracts for improvements to municipal light and power plant as follows: One 400-kw turbine-generator to Murray Iron Works, Burlington, at $21,857; surface condenser to Allis-Chalmers Mfg Co, Milwaukee, $5,495; cooling tower to Cooling Engrg Co, St. Louis, Mo., at $3,525 and boiler to Babcock & Wilcox Co, New York, N. Y. at $20,746. Young & Stanley, Muscatine, are the consulting engineers.

Greenfield has appointed C Max Stanley, Muscatine, as engineer to prepare plans and specifications for $92,500 improvement program for municipal light and power plant. In addition to new building and alterations to existing structure, program calls for a 625-hp Diesel-

HERCULES
Seamless Copper
FLOATS



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Buildings that
"GO MODERN"
go MONITOR

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AIR CONDITIONING, INC.
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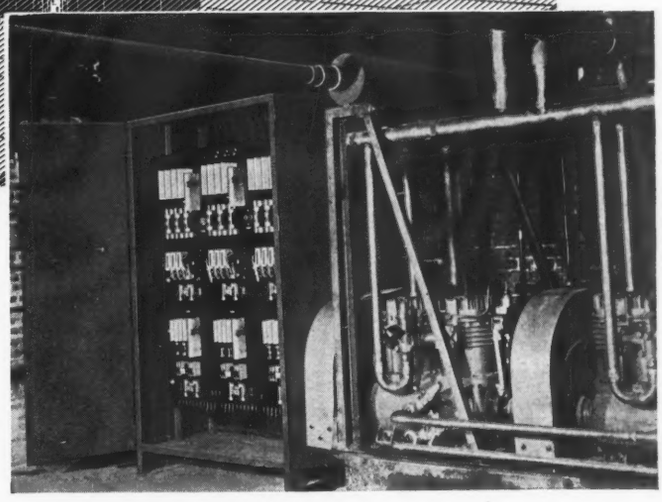

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Monitor Automatic Controls for The Carrier Air Conditioning System in WFBR's new broadcasting studio operate three 15 h.p. Compressors, one 5 h.p. Fan, one 3 h.p. Evaporator and one 1 h.p. Pump . . . "operation of system and controls entirely satisfactory from the start."

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Strange Facts about Fire!

FIRE LOSSES IN U. S.
ARE RISING!
$27,031,000 WAS THE U. S. FIRE LOSS IN MAY, 1939 . . . AN 18% INCREASE OVER MAY, 1938! IN FACT, LOSS FIGURES HAVE BEEN RISING FOR 4 CONSECUTIVE MONTHS. ARE WE PAYING TOO LITTLE ATTENTION TO FIRE PROTECTION?
$27,031,000.
U. S. FIRE LOSS IN
ONE MONTH
BIG FIRE OUT FAST!
IN A RECENT TEST 30 GAL. OF OIL AND GASOLINE BURNED OVER AN AREA OF 120 SQ. FT. A LUX MODEL 100 FIRE EXTINGUISHER KILLED THIS BLAZE IN 13 SECONDS!

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THOUGH LUX CARBON DIOXIDE GAS IS THE FASTEST KNOWN EXTINGUISHING AGENT, IT IS NON-TOXIC, HARMLESS TO MATERIALS. YOU CAN SPRAY IT OVER YOUR BEST SUIT, HOLD IT ON YOUR HAND. LUX GAS DISAPPEARS INTO THIN AIR, LEAVING NO STAIN, NO MOISTURE, NO CORROSION.

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AIM IT LIKE A GUN. FIRE AT THE FIRE! THE NEW KIDDE-LUX MODEL TWO HAS PISTOL-GRIP, TRIGGER-CONTROL FOR EASY ONE-HANDED FIRE FIGHTING. FASTEST WAY TO SMOTHER SMALL FIRES. THERE'S A PLACE FOR THIS FIRE-KILLER IN YOUR PLANT.

Could gasoline, paint, or chemicals cause a dangerous fire in your plant? Could you handle an electrical fire quickly, without damage to delicate wiring? On electrical and flammable liquid fires LUX extinguishers are tops!

For storage spaces, finishing rooms, large electrical motors, Lux Built-In Systems are your best protection. America's foremost utility companies, motor car manufacturers and countless industrials rely on Lux Built-In Systems for hazards like these.

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Would you like to know more about fire . . . how to protect against it? Send for "Don't Play With Fire." It's free. Mail the coupon right now.

Walter Kidde & Company

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Send me "Don't Play With Fire." I understand it describes the new Kidde-LUX, as well as other LUX extinguishers.

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generating unit with miscellaneous equipment and electrical work.

The Worthington Pump & Machinery Co, Chicago, at $28,129, has been awarded contract for furnishing and installing one 500-hp diesel engine in the LaPorte municipal power plant.

Construction Service, Veterans' Administration, Washington, D. C., has low bid from Industrial Heating & Engrg Co, 828 North Broadway, Milwaukee, Wis., at $34,900 for boiler plant at institution at Knoxville, including boiler, stoker, ash-conveying system, etc, and will make award soon.

Bd of Education, Runnels, plans central-heating plant for school. Bond issue is being arranged.

State Bd of Control, Des Moines, will award contracts soon for equipment for power plant at State Training School for Girls, Mitchelville, including boilers, stokers and accessories, and new stack. Henry J Liebee, State House, Des Moines, state architect.

Piper Grocery & Market, Mount Ayr, plans 1-story cold-storage plant addition, with installation of locker system totaling about 250 units. Cash about $25,000, with equipment.

Louisa-Des Moines County Drainage System, Oakville, Edward Yotter, president, Board of Trustees, will award contract soon for new diesel unit for pumping station, including water pumps, fuel oil pump and auxiliary equipment. Stanley Engrg Co, Muscatine, consulting engineer.

Brooklyn has plans maturing for new municipal power plant. Proposed to use diesel-generator units and accessories. Cost about $135,000. Bond issue in that amount is proposed.

Preston contracted Fairbanks, Morse & Co at $45,517 for diesel-generating units and equipment for municipal power plant. Ralph W Gearhart, Cedar Rapids, consulting engineer.

State Bd of Control, Des Moines, has plans under way for new power plant at state penitentiary, Fort Madison, and will take bids at early date. Cost about $170,000, with equipment. H J Liebbe, Des Moines, state architect, in charge.

ILLINOIS——Wishnick-Tumpeer, Inc, 295 Madison Ave, New York, N. Y., manufacturer of chemicals, plans asphalt and oil refining plant on tract of land, 600 x 785 ft, at 51st St and Merrimac Ave, Stickney, near Chicago, recently acquired. Cost about $150,000 with power equipment and operating machinery.

Rath Packing Co, 1600 Sycamore St, Waterloo, Iowa, plans 1-story addition to branch meat-packing and distributing plant at Decatur, 90 x 185 ft, to be equipped primarily as cold-storage unit. Cost about $85,000.

INDIANA——Peru will award contracts soon for improvements in municipal power plant, with installation of equipment. Cost about $28,000.

Bd of Trustees, Indiana Epileptic Village, New Castle, W C Van Nuys, superintendent, will award contracts soon for 300-kw turbine-generator unit and equipment, and 150-000-gal. elevated steel tank and tower, for power house and water supply system at local institution. Bevington-Williams, Inc, Indiana Pythian Bldg, Indianapolis, consulting engineer.

Public Service Co of Indiana announced plans to construct new 50,000-kw generating unit at Dresser. Contracts to be awarded soon.

Richmond is considering improvements in municipal power plant, including new turbine-generator to cost about $500,000; boilers and acessories, to cost close to $220,000 and complete auxiliary equipment. Appropriation is being arranged. R Stevens is superintendent of department.

KANSAS——McPherson will award contracts soon for improvements in municipal power plant, including 5000-kw turbine-generator and accessories, 7500-sq ft surface condenser, and auxiliary equipment. Cost about $163,000, exclusive of building addition. Burns & McDonnell Engrg Co, 107 West Linwood Blvd, Kansas City, Mo., consulting engineer.

KENTUCKY——Bd of Madison County Commissioners, Richmond, has authorized construction of steam power house at local Pattie Clay Hospital for central-heating service. Cost close to $25,000, with boilers and accessories. John T Gillig, Radio Bldg, Louisville, architect.

Louisiana——State Bd of Education, Ruston, has revised plans and will take bids soon for boilers, pumps and equipment for power house and mechanical laundry at local Louisiana Polytechnic Institute. Award recently made to Caldwell Brothers & Hart, 816 Howard Ave.

DO YOU LOSE MONEY WITH E.P.*?

Coppus Blue Ribbon Steam Turbines (Fractional to 150 H.P.) Cut Initial Costs

1 PRECISION WORKMANSHIP
controlled by Johansson Size Blocks

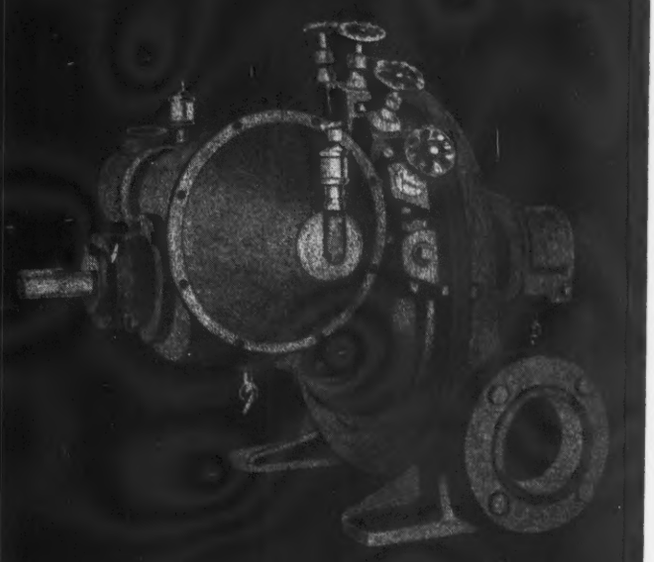
2 ENCASED GOVERNOR
slow speed . . . leverless

3 SEPARATE SAFETY TRIP
Pilot-operated . . . leverless

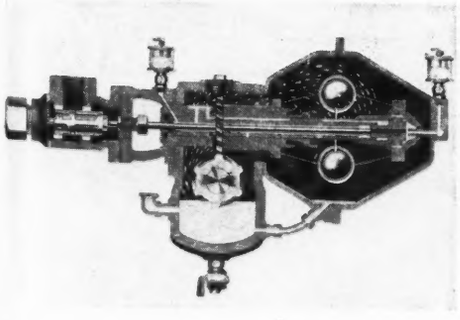
4 PARTIAL LOAD ECONOMY
by individual nozzle control

5 DYNAMOMETER TESTED
before shipment

6 85% REPEAT ORDERS
85.6% in 1937 . . . 86.4% in 1938



Sectional view of governor showing sight feed oil cups and splash lubrication. Coppus Steam Turbines are equipped with slow speed, fly-ball, constant speed governor. The governor head which actuates the valve is directly connected to the turbine shaft by worm and gear, eliminating the back lash of lever connections and thus giving instantaneous action. The governor speed, and through it the turbine speed, can be adjusted while the steam turbine is in operation.



MANY top-rank firms are discovering that they don't have to buy big turbines for small horsepower jobs. They specify the *right size* in COPPUS Blue Ribbon Turbines — and *save* both on investment and installation costs.

You can save by specifying COPPUS, one of whose six sizes will come closest to hitting your job on the nose. Six corresponding prices are easy on your pocketbook.

The Blue Ribbon painted on Coppus Steam Turbines tells you to expect "blue ribbon" performance — the result of design and construction that are described in our free bulletin 135-8. Vertical, horizontal, and with built-in speed reducers. Steam, air, or gas-operated. The bulletin tells all — write for it today — see why other companies always think of Coppus for small H.P. jobs. *Save.*

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★ Elephant Power — an elephant turbine for a small H.P. COPPUS job.

Power Plants, too, have the problem of keeping equipment tightened-up

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CONVEYORS
GENERATORS
STOKERS
PUMPS
RECIPROCATING ENGINES
ASH HANDLING EQUIPMENT

Fig. 1513
Pat'd &
Pats. Pending

These are but a few of the types of power plant equipment where vibration, shaking and jarring are continually loosening-up ordinary nuts. Apply "Unshako" Self-Locking Nuts and be rid of this problem for all time. Built-in locking rings hold them tight, yet they can be easily removed with an ordinary wrench, if necessary, and re-used many, many times. "Unshako" Nuts are self-contained . . . no washers, pins or other gadgets to fuss with. Write for full details.

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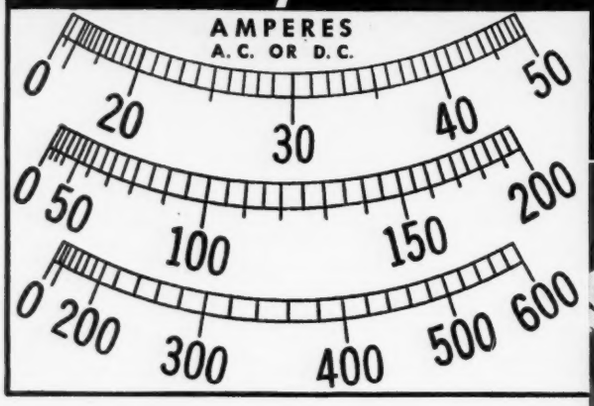
Ten Easily Read Scale Ranges



A typical combination of ranges furnished with the Type AX Tong Test are shown at the left.

Tong Test Ammeters are more quickly and accurately read because each of the ten scale ranges available has only one set of large numerals and each is a separate, hand-calibrated unit. Shown above actual size, these scale ranges are instantly interchangeable and one instrument can be furnished with one or more of the several scales which exactly meet your operating conditions.

Tong Test is the only ammeter of this type having these easily-read scale ranges; the only one which can not burn out or be damaged electrically; the only one which measures both A.C. and D.C.

Tong Tests measure up to 1,000 amperes. May we send you a bulletin describing them or arrange a demonstration?

COLUMBIA ELECTRIC MFG. CO.
4501 Hamilton Avenue **Cleveland, Ohio**

TONG TEST AMMETERS

New Orleans, at $172,613 for such equipment has been rescinded. Edward F Neild, City Bank Bldg, Shreveport, architect. Main offices of Board at Baton Rouge.

Lake Providence contracted Fairbanks, Morse & Co, Chicago, Ill., for diesel generator and equipment for municipal power plant, where improvements will be carried out. Award for building extension has been made to Glassell General Construction Co, Shreveport. Cost about $125,000. C A Peerman, Monroe, consulting engineer.

Eunice contracted Littrell Contracting Co, Inc, Opelousas, at $52,689, for installation of a pressure pipeline system for municipal natural-gas distribution.

Ruston plans addition to municipal power plant and waterworks station, including installation of a 1000-hp engine-generator and equipment. Cost about $88,000. Work scheduled to be carried out this fall.

Fairfield Properties Corp, owners of United Gas Bldg, Shreveport, announces award of contract for four Westinghouse elevators at $85,000 to Westinghouse Electric Elevator Co, Jersey City, N. J. Edward F Nield, company architect, and Werner Co, Inc, general contractor.

MARYLAND——Delmarva Power Co, Vienna, operated by Eastern Shore Public Service Co, Salisbury, plans new steam-electric generating plant. Cost about $1,000,000, including line extensions.

Fairfield Western Dairy Corp, 1125 Linden Ave, Baltimore, plans milk and milk-byproducts plant on 10-acre tract of land on Loch Raven Rd, near junction of Baltimore & Ohio Railroad, comprising several 1-story units, with power house and service buildings. Cost about $1,600,000. Work is scheduled to be carried out this fall.

MICHIGAN——Bd of Education, Battle Creek, plans central-heating plant in Lakeview district for school there. Cost reported over $40,000, with boiler, accessories, coal-handling and other equipment. Lewis J Sarvis, Battle Creek, architect.

Grand Rapids contracted Owen-Ames-Kimball Co, Grand Rapids, for 2 main pumping stations and wet well for waterworks system at $384,986. City is building new pipline from Lake Michigan for main water supply.

Bd of Trustees, Michigan State College, East Lansing, plans addition to power plant at institution, with installation of equipment for increased capacity. Work will be carried out this fall. Cost about $130,000.

MINNESOTA——Wheaton plans municipal power plant. Surveys and estimates of cost have been authorized. G M Orr & Co, Baker Arcade Bldg, Minneapolis, consulting engineers.

Herman Grocery Co, Ada, plans addition to cold-storage locker plant, with installation of additional locker units. Cost close to $25,000.

Herman Mankenburg, Elgin, meat dealer, plans 1-story cold-storage and refrigerating plant on adjoining site, with locker system. Cost about $30,000, with equipment.

MISSISSIPPI——Pascagoula plans natural-gas distributing system, including main welded-steel pipeline for connection with supply scource, control station and other operating facilities. Cost about $360,000. Bond issue is being arranged.

Waveland plans municipal pressure pipeline system for municipal natural-gas distribution, including control and regulator station, and auxiliary structures. Cost about $47,000, in which amount bonds have been approved.

Natchez plans installation of diesel engine units and equipment in waterworks pumping station, in connection with improvements in water system to cost over $200,000. Wiedeman & Singleton, Candler Bldg, Atlanta, Ga., consulting engineers.

MISSOURI——Bd of Public Works, City Hall, Kansas City, plans central-heating plant at new city hospital No. 2, for which bids will be asked in October. Entire project will cost about $250,000. A W Archer, Pioneer Trust Bldg, architect.

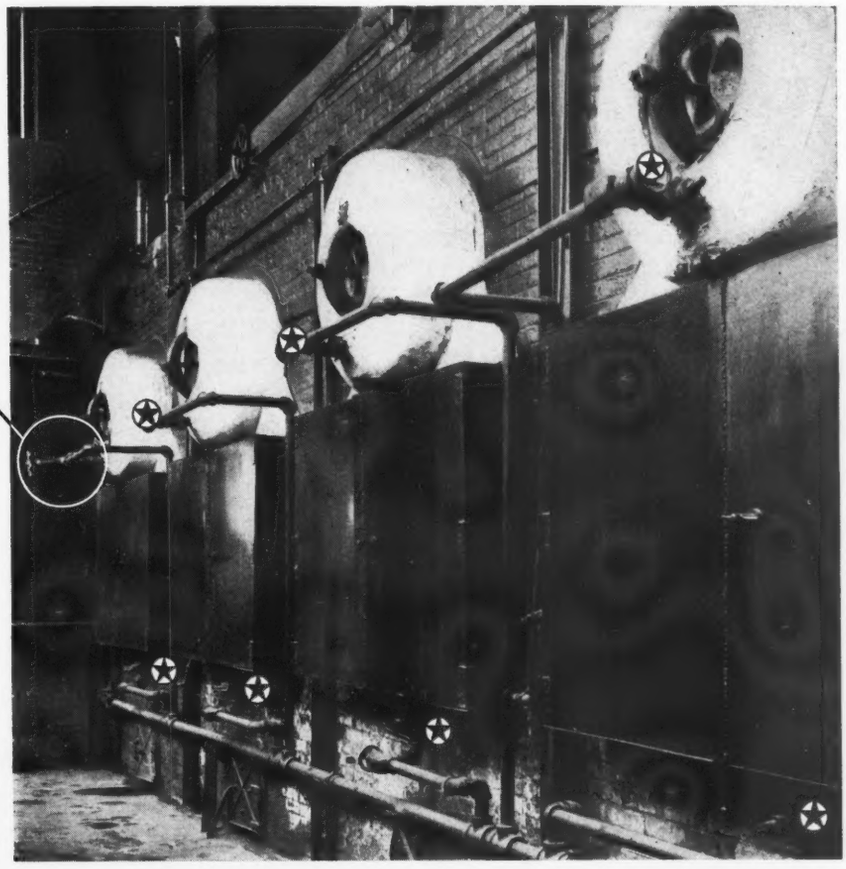
MONTANA——Forsyth plans new municipal power plant. Proposed to use diesel-generators and accessories. Estimates of cost and surveys are being made. F F Palmer, city engineer, in charge.

NEBRASKA——Blair contracted Busch-Sulzer Brothers Co, St. Louis, Mo., for 600-kw diesel-generator and accessories, at $56,236, for municipal power plant. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

185 Years of Service

from Eight HOMESTEAD Boiler Blow-Off Valves

Where boiler laws require two valves on blow-off line the Hovalco Angle Valve is combined with Quarter-Turn Plug Valve as in this installation, or with Lift-Plug Valve as shown above. Made in 1½", 2", or 2½" sizes for pressures to 600 pounds, or higher on order.



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Individual continuous service records for these valves range from 17 to 34 years. They have been operated three times every twenty-four hours, on 150 pounds pressure, at 369° to 385° F., and are still going strong.

That is outstanding low-cost valve performance—the type of service given by Homestead Valves in industrial plants everywhere for nearly half a century—and that confirms the experience of thousands of users, who have found that Homestead Valves are lowest in first cost, upkeep, and cost per year.

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PROTECTED-SEAT VALVES:
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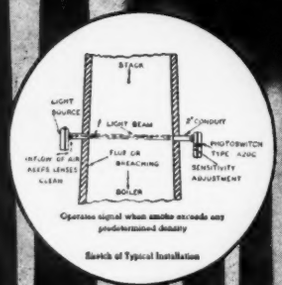
Electric Eye
INCREASES FUEL ECONOMY—AVOIDS SMOKE NUISANCE



Operates signal when smoke exceeds any predetermined density
Sketch of Typical Installation

DEPENDABLE—RUGGED
• GUARANTEED •

SOLVES YOUR OTHER CONTROL PROBLEMS
Wherever objects are counted, electrical machinery automatically controlled, or warning signals are used, PHOTOSWITCH will do the job better and more economically.
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PHOTOSWITCH INCORPORATED
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Quieting 15,800 lbs. of steam per hour with a MAXIM BR9

WITH the new MAXIM SILENCER, MODEL BR9, our engineers have developed an efficient, practical, easily installed means of taking the noise out of high velocity steam, air or gas discharges—an ideal method of quieting the roar from safety valve and relief valve discharges.

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THE MAXIM SILENCER COMPANY
HARTFORD, CONN.
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Another HILCO!
for COLUMBIA QUARRY CO.

Another unit now ASSURES the SAME LOW COST at their COLUMBIA PLANT

LOWER OPERATING and MAINTENANCE COSTS resulted from the HILCO OIL RECLAIMER installation at the VALMEYER PLANT

This same HILCO OIL RECLAIMER will give you the same uninterrupted Service and Savings that the Columbia Quarry enjoys. Start saving Today by getting the Facts. Write for your copy of Oil Reclamation.

MODEL G. HILCO
Model G-Hilco with panels removed to show mechanism.

Read what Dr. C. H. Krause, Vice Pres. says:

"After considerable experience in using other types of oil purifiers, we have definitely proved—in dollars and cents saved—that Hilco is superior to anything on the market today. And that is why we bought ANOTHER HILCO.

THE HILLIARD CORPORATION
4 WEST 4TH ST. ELMIRA, N. Y.

Schuyler will award contracts soon for a 1000-kw turbine-generator and accessories, 1600-sq ft surface condenser and auxiliary equipment for municipal power plant. Cost estimated about $50,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

NEW JERSEY——Pyrene Mfg Co, 560 Belmont Ave, Newark, has approved plans for 2-story addition to fire-extinguisher-manufacturing plant, 130 x 190 ft. Cost over $100,000, with power equipment and machinery. Work will be placed under way at once.

NEW YORK——Bureau of Yards and Docks, Navy Dept, Washington, D. C., contracted Riley Stoker Corp, Worcester, Mass., at $379,863 for boiler units for power plants at Brooklyn, Norfolk and Portsmouth, Va., navy yards, and Pensacola, Fla., naval air station. Also made award to Dravo Corp, Neville Island, Pittsburgh, at $87,890 for boiler unit and auxiliary equipment for installation in power house at naval academy, Annapolis, Md. (Specifications 9289).

American Brake Shoe & Foundry Co, 1673 Bailey Ave, Buffalo, plans modernization of plant, including installation of air-conditioning system in molding department, automatic conveyor system and other work. Cost about $75,000. Main offices of company are at 230 Park Ave, New York.

NORTH DAKOTAS——Five-Star Rural Electric Cooperative, Inc, Devils Lake. E A Walker, secretary-treasurer, plans electric-generating station in vicinity of Whitman for power supply for rural electric system. Fund of $40,000 has been secured through Federal aid. Proposed to ask bids soon. Ellerbe & Co, First National Bank Bldg, St. Paul, Minn., consulting engineers.

OHIO——Lake County Memorial Hospital, Washington St, Painesville. Leo Merrills, board chairman, plans addition to power house at institution, with installation of boilers, pumps and auxiliary equipment, in connection with new hospital building. Cost about $470,000. Financing is being arranged.

H H Meyer Packing Co, 2115 Linn St, Cincinnati, Ohio, has plans for improvements in power house at meat-packing plant, with installation of additional equipment. Award for 400-kw motor-generator set has been made to Ideal Electric & Mfg Co, Mansfield, Ohio, and other contracts will be placed soon. Fosdick & Hilmer, Union Trust Bldg, Cincinnati, engineers.

New Philadelphia is considering preliminary plans for municipal light and power station. Estimates of cost are being made.

Bd of Trustees, St. Joseph's Riverside Hospital, Warren, will award contracts soon for 2-story power house, 63 x 78 ft., and mechanical laundry at institution, to include 1500 sq ft boilers and accessories, vacuum and feedwater pumps, conveyors and other equipment. Leich & O'Brien, Union Savings & Trust Bldg, architects.

Madison Food Products, Inc, 5201 Denison Ave, Cleveland, plans boiler plant at factory at Medina. Cost close to $40,000 with boilers and equipment. Ernest McGeorge, 9400 Quincy Ave, Cleveland, consulting engineer.

Producers' Milk Co, 4560 West 35th St, Cleveland, plans installation of a cold-storage and refrigerating plant in new 2-story ice cream factory, 50 x 60 ft. Cost over $60,000, with equipment. Richard Wisemeyer, assistant manager, in charge.

Bd of Trustees, Miami University, Oxford, plans improvements in power house at institution, including new boilers to replace present units. Equipment awards are scheduled to be made soon. John P Schooley, State Office Bldg, Columbus, state architect and engineer.

OKLAHOMA——Newkirk plans improvements in municipal power plant, including installation of additional equipment. Estimates of cost are being made.

OREGON——Bd of Grant County Supervisors, Canyon City, will take bids soon for central-heating plant at local courthouse. Bids recently received have been rejected.

Tide Water Associated Oil Co, Pittock Block, Portland, has taken out a permit for boiler house at oil-storage and distributing plant at 11,400 N W St. Helens Rd. Cost close to $25,000 with boilers and auxiliary equipment.

PENNSYLVANIA——United Engrg & Foundry Co, First National Bank Bldg, Pittsburgh, manufacturer of heavy machinery, plans additions to branch plant at Youngstown, Ohio, including improvements in present works. Cost close to $750,000.